A SHORT TEXTBOOK
OF
SURGERY

By

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PREFACE TO THE SEVENTH EDITION

Now that this book has come of age it is fitting to look back over the twenty-one years and recall the quite remarkable crescendo of surgical progress during this time.

In 1938 when the first edition appeared surgeons were still much occupied with the treatment of infective diseases including wound infections, osteomyelitis, the venereal diseases and all the myriad manifestations of tuberculosis Now antibiotics have brought nearly all of them under effective control and even the emergence of resistant strains has served only to emphasize the changing scene

During this time also there have been some notable extensions in the field of surgery particularly in the heart and blood vessels, and even some modest success, by endocrine methods, in the treatment of advanced malignant disease Improved anæsthesia has made operating easier and therefore safer the blood transfusion service has removed the hazard of hæmorrhagic shock, and numerous technical improvements have reduced the risks of operation

These achievements of surgical craftsmanship have moreover been matched by even greater advances in surgical science Methods such as paper chromatography and flame photometry have brought biochemistry to the bedside. An operation is no longer an anatomical *jeu-de théâtre* but a physiological exercise and every phase of after-care is under laboratory guidance

Such developments, and others too numerous to mention have been reflected in succeeding editions of this book Even since the last edition appeared four years ago a great many changes have become necessary to keep pace with advances in surgical practice. Many sections have been re-written or radically altered and few pages have escaped minor amendment A few worn out blocks have been discarded and more than fifty new illustrations, mainly the work of Mr Gabriel Donald, have been added. In keeping with the policy of recent editions, all obsolete material has been ruthlessly jettisoned and subjects of diminishing importance reduced to small print. In this way it has been possible not merely to avoid enlargement but even to achieve a quite substantial reduction in size

C F W ILLINGWORTH

EXTRACT FROM THE PREFACE TO THE FIRST EDITION

With the growth and increasing complexity of the surgical specialties, the task of preparing single-handed a comprehensive textbook of Surgery grows steadily more formidable. Yet the very diversity of modern surgical practice emphasises the continued need for textbooks which will give a balanced account of the whole field of surgical work from the standpoint of the general surgeon

I have endeavoured to mould this book in a form suitable for undergraduate and postgraduate students, avoiding on the one hand the imperfections of the smaller handbooks and on the other the encyclopædic unwieldiness of compilations I have tried to make it comprehensive and yet, by economy of phrase, to keep within the bounds of a single volume and by the use of simple English constructions and logical sequences, to make it readable.

I must confess a lack of experience in certain of the special branches of Surgery which will doubtless be reflected in the chapters devoted to those subjects However I hope to have made the book suitable for the general reader as for the specialties, the most I can hope is that my neurology will satisfy the urologists, my gynæcology the orthopædists

The writer of a textbook must marshal his facts from many sources from older textbooks, monographs and current literature. Since in a book of this size it would clearly be impossible to quote all one's authorities, whilst to quote a few would be invidious, I have refrained from indicating references in the text. Instead, I wish to make a general acknowledgement of my indebtedness to all such sources of information.

C F W ILLINGWORTH

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CHAP

CHAPTER I

SAFETY FACTORS IN SURGERY

It cannot be doubted that future progress in surgery is to be gained not in inventing new technical procedures or in invading new fields but in eliminating the risks at present incident to operation. This must be done first by thorough pre-operative examination designed to assess the special risks in each case and to exclude patients unfit for surgery; secondly, by careful preparation to fit the patient for what may prove to be a test of physical endurance; and thirdly, by post-operative care to prevent or treat any complications.

Assessing the Risk of Operation. Before advising operation the surgeon must ask himself the following questions. Is the patient fit for operation? Is the type of operation proposed one that the patient is fit to undergo? Is the operation one necessary to preserve life, in which case certain risks must be faced, or one that may be postponed or avoided? If operation is necessary, how can the technique be adjusted to minimise the risks?

Apart from the routine clinical examination of heart and lungs and urine, it is very important to assess the patient as a whole. His facies, nutrition, attitude and general bearing offer evidence to the practised eye. When possible, he should be examined standing so that if necessary his capacity for effort can be studied. In the majority of cases such an examination, carefully performed, will suffice along with the history to pass the patient as fit for ordinary operative procedures.

In patients whose fitness to undergo operation is not beyond question further examination is necessary. The cardiovascular system requires special care. The pulse rate, the blood pressure, the state of the capillary circulation, the condition of the heart and blood vessels, and particularly the response to effort, must all be taken into account, bearing in mind also the extent and severity of the operation to be performed. Routine blood examinations and blood group tests are done, and electrocardiography may be advisable. A straight X-ray of the chest may be required.

Pre-operative Preparation. A young healthy person, admitted for an operation of small or moderate severity, requires little pre-operative preparation; in fact, the less the better. The old method of strict starvation and powerful purgation is now known to be inadvisable, and no preparation is required other than to put the patient on a light diet for the day before operation, to administer a mild aperient, and to give a simple enema.

In patients in impaired health, especially if a major operation is contemplated, more prolonged preparation is advisable. The patient

should be admitted to hospital several days before operation A few days' rest in bed makes a great difference to the over strained business man or the tired housewife. A high protein diet rich in carbohydrate should be given Alcohol should not be withheld from a patient who has been accustomed to it.

The fluid balance may need special attention with intravenous infusion of saline and glucose (p 4) If the hæmoglobin level is low much improvement is effected by one or more transfusions of blood or packed red cells, given several days before operation to enable tissues damaged by anoxia to recover Other special measures are needed in special types of cases.

Operation Room Technique. The proper performance of surgical operations demands of the surgeon a high degree of experience and

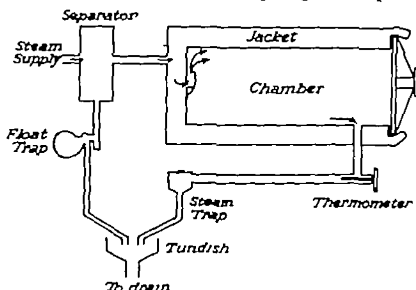


FIG. 1 Steam steriliser. Steam at 121 –126° C. circulates through jacket and, entering chamber displaces air downwards. Note thermometer on exit tube.

skill, and meticulous attention to detail of his staff foresight, willing service and eager co-operation, and of the whole team a rigorous discipline of aseptic technique.

The master surgeon of to-day is no mere skilful wielder of the scalpel Surgery is no longer a simple compound of anatomy and dexterity rather it demands a knowledge of physiology and pathology clinical acumen and judgment. Speed in operating is no longer a *sine qua non* many of the greatest surgeons are notably slow operators, and none should achieve quick operating at the expense of careful technique. In former days, when anæsthetics were but newly introduced, a surgeon's skill was assessed by the number of seconds he required to amputate a thigh now the only proper criterion must be based on end results.

Consistent success in surgery demands a scrupulous aseptic technique. The patient's skin, the surgeon's hands, the air of the operating theatre, the instruments and dressings must all be maintained in a state of as

complete sterility as may be possible, and the whole conduct of the surgical team must be organised to prevent contamination

The patient's skin over a wide area round the site of operation demands careful preparation, for saprophytes and potential pathogens such as *Staphylococcus aureus* abound The skin should be shaved cleaned with alcohol and painted with an antiseptic such as Cetavlon or Hibitane in alcohol. Even then it may not be completely sterile, so once the incision is made towels must be clipped to the wound edges to ensure that no contamination comes from this source

The surgeon's hands are difficult to sterilise Reliance must not be placed on the protection offered by rubber gloves, for the gloves often are torn during operation. The difficulty is increased by the fact that many antiseptics suitable for a single application to the patient's skin cause dermatitis if used frequently by the surgeon.

The surgeon must keep his hands in good condition, with the nails well trimmed. He should at all times avoid contact with potentially virulent infection and must never touch a septic wound with the un gloved hand. He must never operate if he has a sore throat or a boil or other infective process in the skin.

Air borne infection of wounds during operation occurs most readily in prolonged operations. Air borne contamination from the nose and throat can be controlled by the use of impermeable face masks, which should be compulsory for surgeons, assistants and spectators. The theatre should be ventilated by filtered air from outside rather than contaminated air sucked in from wards and corridors.

Methods of Sterilisation. Instruments, thoroughly cleaned with soap and water are sterilised in boiling water or a suitably designed autoclave. Boiling will destroy all organisms but not spores. Sharp-edged or pointed instruments, which would be blunted by boiling in water may be boiled in oil or sterilised in strong lysol or Dettol solution Spirit, though in common use, is inefficient as a sterilising agent.

Dressings, towels and swabs are sterilised by exposure to steam usually at 15 to 20 lb pressure per square inch. This moist heat at 121° to 126 C. is essential to destroy spores, for example the spores of tetanus, which are commonly present in raw wool.

The materials are packed loosely in bags or fenestrated drums and placed in the autoclave, which is heated by admitting steam to the jacket and chamber All the air must be removed preferably by a high vacuum pump or by gradual downward displacement of the air by steam. The steam then percolates down through the materials, con densing as it does so The resulting transfer of latent heat in the presence of moisture will exert maximum effect. After the appropriate time has elapsed, depending on the method of packing the temperature and pressure, and ranging from twenty to fifty minutes, the materials are dried quickly by passing warm filtered air through. Browne's tubes which should change colour from red to green, may be inserted with the materials in each bag as a routine, while bacteriological checks are occasionally desirable.

Post-operative Treatment. During any operative procedure the patient loses body heat, sustains a certain amount of shock (generally of small degree) and suffers some deprivation of the glycogen reserve.

As a routine after operation the body temperature must be maintained by hot blankets and bottles, but excessive heating must be avoided Morphia or other sedative should be given to ease pain and diminish restlessness In major cases intravenous saline, glucose, plasma or blood may be required.

Special care must be taken to reduce the risk of post-operative pulmonary complications. To this end the patient must be propped up as soon as possible after recovery from the anæsthetic, and deep breathing should be encouraged to increase the pulmonary ventilation. In special cases it is useful to administer a mixture of carbon-dioxide and oxygen to stimulate respiratory movement.

As a rule, the bowels remain closed for two or three days Often no aperient is required and the bowels work naturally when normal feeding is resumed If not, a mild aperient may be given If " gas pains are severe—an unusual feature with modern operation technique—a small enema may be given.

After operation the patient must be encouraged to move actively from the first. Early ambulation is desirable in many cases. For example, after appendicectomy or herniotomy or gastrectomy many surgeons advise that the patient be got up on the second or third day In elderly people particularly this plan is desirable.

Fluids and Electrolytes. In health, water by the mouth is needed to balance the invisible loss (lungs and skin) and to procure adequate urinary excretion. In a temperate climate about 1500 ml. is needed in the twenty four hours. This balance is often disturbed by disease or after operation Thus the intake may be reduced if there is nausea or vomiting or if the patient cannot swallow or is too ill or too confused to drink while the output may be increased in fever (loss from lungs and skin) or by sweating, vomiting, diarrhœa or fistulous discharge. In addition there may be, e g in intestinal obstruction a hidden loss of fluid stagnant in the intestinal lumen

The important electrolytes are sodium and potassium. Sodium, the predominant extra-cellular electrolyte, has no specific action and its function is to conserve the isotonic equilibrium and so maintain the volume of extra-cellular fluid It is a kind of osmotic stuffing On the other hand potassium, the main intra-cellular electrolyte, plays a much smaller part in osmosis (being in relatively small amount) but has important specific effects on the nervous system and in moderating the contractibility of muscles.

Moreover there are other differences Sodium is present in large amount so a moderate loss is not serious, and there is an efficient mechanism (aldosterone effect on the renal tubules) which conserves sodium by preventing its secretion in the urine. Potassium, on the other hand, is present in limited quantity and there is no mechanism for conserving it, so an acute deficiency may develop quickly especially if

the intake is reduced and the output increased by vomiting The most dangerous restriction arises when acute potassium deficiency is combined with alkalosis (hypokalæmic alkalæmia) as in pyloric stenosis The symptoms include profound weakness collapse, abdominal distention, and mental disturbances such as confusion, apathy and drowsiness.

Metabolic Results of Operation. After any major operation or injury certain biochemical changes are inevitable. The urinary output falls to 500 ml or less for the first twenty four hours (probably due to excess of anti-diuretic hormone) The nitrogen content of the urine increases even as high as 25 G daily (probably due to muscle wasting and increased when muscles are injured) The potassium content of the urine increases (due to potassium set free in the same process) These changes are inevitable and not harmful and call for no treatment.

Assessing Water and Salt Balance. There is no ready method of assessing water and salt balance, and laboratory investigations may be misleading unless interpreted skilfully

A fluid balance chart should be kept, giving for each twelve hours on the intake side the volume of all fluids given by mouth or parenterally and, on the output side, the volume of urine, vomit, diarrhœa, etc. The invisible loss is usually assessed (or guessed) at 450 ml (15 oz.) for twelve hours. These charts have the serious defect that they take no account of hidden loss into the lumen of the intestines.

The urine volume is important. Except for the first twenty four hours (see above) it should measure 900 ml (30 oz.) a day or much more if the kidneys cannot concentrate it.

Urinary chloride estimation by the Fantus test was advised formerly but the urinary chlorides disappear early in all electrolyte disturbances owing to the aldosterone conservation mechanism so their absence is not significant.

Blood levels of sodium and potassium are readily estimated by flame photometry and should be done as a routine, though owing to reciprocal shifts between cells and plasma, and changes imposed by acidosis or alkalosis they must be interpreted with caution. (Normal values serum sodium 300–350 mg per 100 ml. or 130–150 mEq /l. Serum potassium 14–21 mg per 100 ml. or 3 5–5 5 mEq /l)

In potassium deficiency a better guide is the electrocardiogram in which inversion of the T wave, depression of the ST segment and prolongation of the QT interval may be observed but these changes are not always present and may be obscured in myocardial disease.

Water and Salt Replacement. Ideally, water and the particular electrolyte should be replaced weight for weight for what has been lost. In practice this is not possible and the fluid to be given is assessed partly on clinical criteria, partly on laboratory data and partly on general experience. Thus we know that after an uncomplicated major operation the fluid needed during the first twenty four hours is rarely more than 2 litres and that potassium will rarely be required whereas in pyloric stenosis or intestinal obstruction as much as 10 litres may be required, including

perhaps 2 litres of potassium solution The look of the patient, the character of the pulse, the amount of vomit, the presence of special symptoms and other relevant features, will modify these considerations.

The dangers of excessive infusion must be borne in mind Too much sodium will lead to pulmonary œdema, too much potassium may cause sudden death in cardiac diastole. Too rapid infusion of any type of fluid may embarrass the right side of the heart. (To avoid this last complication watch the cervical veins and slow the drip if they become distended.)

The fluids in general use are Ringer's solution, 5 per cent. glucose in water and a potassium replacement solution' containing 0 38 per cent. potassium chloride. Note that 'normal or "physiological" saline is neither normal nor physiological and should not be used. The glucose water enables one to give water without electrolyte and is useful to avoid sodium overdosage. Unless there are special instructions to the contrary it is a good plan to give one bottle each, in turn of Ringer, glucose and potassium

Technique of Intravenous Infusion. If possible, a forearm vein should be used A sphygmomanometer cuff is applied to the arm and inflated to 90 mm. Hg to distend the vein The needle is then held with

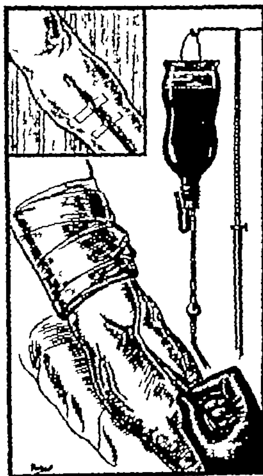


FIG. 2. Intravenous infusion.

the bevel up inserted through the skin to one side of the vein, then into the vein and along the lumen for a centimetre or so to prevent dislodgement. A spurt of blood from the needle signifies that the vein has been entered The cuff is then deflated and the needle connected with its tubing The base of the needle is held to the skin by adhesive strapping as also is the rubber tubing a few inches down the limb For further security the limb should be splinted, preferably in a light plaster splint incorporating the needle butt. The limb should be elevated to prevent venous congestion To prevent reflux of blood into the needle, the usual cause of clotting and blockage of the tube, take care that the flow of fluid is never interrupted

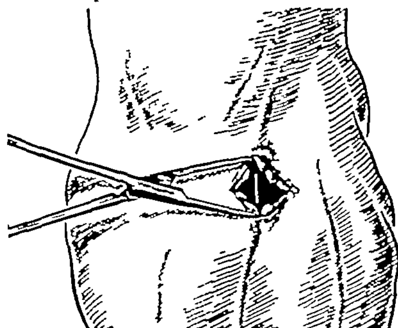


FIG. 3. Intravenous infusion. Cutting down on the vein. A small transverse incision is made. The vein is then defined by means of a hæmostat.

Fig 2 shows the method in use. Often it is possible to use a vein lower in the forearm or on the dorsum of the hand, to conserve the median basilic vein against an emergency If attempts to needle a vein fail, it is necessary to cut down (Fig 3) A forearm vein may be used, or the median cephalic in the upper arm, or the saphenous at the medial side of the shin or the great saphenous in the groin If continued infusion is desired, a fine polythene tube may be threaded through a needle and some distance up the vein (the needle then being removed) so that the infusion fluid will be rapidly diluted as it leaves the tube. This reduces the risk of thrombophlebitis. When irritant fluid is to be given over a long period, e.g in the treatment of anuria, a polythene tube inserted through the saphenous at the groin is threaded up to the vena cava (caval drip)

Administration of Protein

After any surgical operation or other forms of trauma there occurs a ' katabolic phase with excessive protein breakdown and a loss of nitro-

genous bodies in the urine. After most operations it has little practical significance and after a few days the balance is restored by ordinary feeding. After severe trauma or a major operation the katabolic phase is increased, even though the protein intake is maintained, and correspondingly greater leeway requires to be made up during convalescence. Apart from this, protein deficiency may result from starvation, from faulty absorption (e.g. due to gastrocolic fistula), from increased needs (as in prolonged fever) or from excessive loss (as in hæmorrhage, burns, intestinal obstruction).

The lack of protein impairs wound healing and if severe, by diminishing the osmotic pressure it may lead to generalised œdema.

An ill patient commonly requires a high protein intake to make good what he has lost and to balance his increased needs. A daily intake of 200 gm. of protein is often desirable. But such an intake in the diet may cause nausea even in health, and in illness often is quite impracticable. In these circumstances it is helpful to supplement the diet by casein hydrolysate.

Antibiotics in Surgery

The introduction of antibiotics produced a revolution in surgery second only to Lister's discovery of the causes of wound infection. In the light of these changes it is interesting to look back on the first edition of this textbook which was written before the introduction of penicillin. Since then erysipelas and other streptococcal infections, gas gangrene, pneumococcal diseases, osteomyelitis, syphilis, gonorrhœa and even tuberculosis have almost disappeared or at least ceased to be major problems of surgery. A wound of the kneejoint no longer means permanent crippledom; an infected finger no longer implies economic disablement; a carbuncle of the lip no longer spells acute danger to life. But we have learnt that antibiotics are not free from danger both to the individual patient and the community at large, and there are indeed some people who predict that unless their use is strictly limited resistant strains of organisms will grow more and more freely until once again the surgical conditions of former years will prevail.

So far as concerns the individual patient the dangers of treatment by antibiotics are twofold, due respectively to the toxic effects of the particular drug and to the development of resistant strains.

Toxic Effects. While far fewer than with many other types of drugs these can be serious in a small proportion of cases. *Sulphonamides* often give rise to malaise and vomiting and sometimes to sensitisation effects with pyrexia and various skin reactions. *Penicillin* is still the least toxic of the antibiotics but occasionally causes skin rashes. *Streptomycin* carries the particular risk, serious but fortunately rare, of permanent damage to the vestibular and acoustic nerves. The *tetracyclines* occasionally cause pyrexia and skin rashes while *chloramphenicol* has given rise to fatal cases of aplastic anæmia.

Resistant Strains. The development of these is not seen with the sulphonamides but can occur with all the later antibiotics. One result

is that the infective process under treatment neither resolves nor comes to a head but persists as a chronic inflammatory mass which may resist treatment for many months. This is seen often in acute mammary abscess, or in puerperal infection where a "frozen pelvis" occurs with extensive granulomatous masses and numerous adhesions. A more dangerous result, seen especially after oral administration of the tetracyclines is that destruction of most of the normal intestinal flora leaves the way clear for resistant strains and leads to thrush infection of the mouth and severe and often fatal staphylococcal entero-colitis.

General Principles of Treatment. (1) To minimise these dangers antibiotics should only be used when a clear indication is present. They should not be used as prophylactics except for operations on the œsophagus and colon. In these cases an insoluble sulphonamide such as succinyl-sulphathiazole is preferred and if a tetracycline is used it should be discontinued within three days.

(2) Unless quite impracticable, they should only be used where the infecting organism has been shown to be sensitive.

(3) Subject to bacterial sensitivity the least toxic drug should be used. Penicillin is in widest use. Sulphonamides are generally effective for diseases of the bowel and urinary tract. The tetracyclines should only be used where specifically indicated. Erythromycin should be kept in reserve to be used when all else has failed.

(4) Whichever drug is used it should be given in full doses from the start, and apart from particularly stubborn infections such as osteomyelitis, endocarditis, and, of course, tuberculosis, it should not be maintained for more than five days.

Complications of Operation

Cardiac Arrest. Heart failure in a patient known to be grievously ill, e.g. with previous myocardial damage or hypertension or severe hæmorrhage is sufficiently distressing but sudden stoppage of the heart action in a fit patient during or after a standard operation is an unmitigated tragedy. Sometimes it is due to anæsthetic overdosage or to the action of anti curare drugs, but often the cause cannot be determined. However if energetic steps are taken at once there is a good prospect of restoring the heartbeat. It is therefore essential that every surgeon should know the correct procedure and be prepared to take action on the instant. Delay is fatal, for if more than two or three minutes elapse the central nervous system will suffer irretrievable damage.

The first step is to see that the airway is patent and to give oxygen. Then, without waiting to see the effect of this action, cardiac massage must be performed. It must be done through a chest incision, even if the abdomen is already open. Without waiting to wash up or arrange towels or even cleanse the skin, one must take up a knife and slash rapidly along the fourth or fifth interspace through into the pleural cavity over a distance of 6 inches or so. The hand is quickly inserted and the heart compressed through the intact pericardium. Compression at the rate of about 40 beats a minute is maintained.

By this means sufficient circulation can be kept up to prevent cerebral anæmia, so at this stage there is time to plan ahead If a rib-retractor is available it is introduced to give more room for the hands the head of the table is lowered the airway is again checked artificial respiration can be given

If the heart is flacid 10 ml. of 1/10 000 adrenalin is injected into the lumen of the left ventricle (1ml of 1/1000 adrenalin in 9 ml water) If the heart is fibrillating a defibrillator which should be available in every hospital is sent for The pericardium is opened the cup-shaped electrodes are applied in close contact with the heart muscle, and four or five electric shocks each of one-tenth second given in rapid succession Failing this, 1 ml. of 5 per cent. procain amide is injected into the ventricle. The massage is continued until the heart is beating regularly

The wound is then closed after inserting a drain, preferably of Pezzar type through a stab incision over one of the lower inter spaces. No attempt is made to close pericardium or pleura, but only the pectoral muscle layer and the skin The drain is connected to a water seal in order to prevent ingress of air Antibiotics are given to counteract the inevitable contamination

Post-operative Vomiting The majority of patients after operation have little or no nausea and no vomiting and in cases in which vomiting persists more than a few hours some other cause should be sought, e.g acidosis, acute dilatation of the stomach, adynamic ileus, peritonitis, intestinal obstruction or toxic damage to the liver or kidneys.

The treatment in such cases depends upon the cause. Generally the first step is to wash out the stomach and to replace the lost fluids and electrolytes by a saline infusion.

Gas Distension. Post-operative gas distension may be due entirely to air swallowed during anæsthesia or in the post-operative period Air swallowing occurs especially during periods of nausea or retching or in attempts to vomit. Acute distension of the stomach arises, and the small intestines also become dilated

Gas distension can be prevented by gastric suction in the post operative period, as is commonly practised after operations on the stomach. In the treatment, the most effective measures are to empty the stomach by means of a nasal tube and to deflate the colon by means of an enema.

Occasionally in states of severe dehydration gas distension is due to potassium deficiency The remedy is to replace the loss by intra venous infusion.

Hiccup This very distressing fatiguing and sometimes dangerous complication is especially apt to follow operations upon the abdomen or urinary tract. Frequently its cause is to be found in a dilated stomach or colon. In other cases hiccup is an indication of impending uræmia

The treatment is difficult. In mild cases it suffices to give chloroform water or peppermint. If these and other simple measures fail, the

stomach must be washed out. Flatus enemas are given to empty the colon. Care must be taken that an atonic distended bladder or some other cause of renal impairment is not overlooked. If renal impairment is regarded as a possible factor it is advisable to force fluids, if necessary by means of an intravenous drip. The administration of carbon dioxide at intervals sometimes appears to be of value. To afford the patient some rest from the fatiguing spasms it may be necessary to administer a powerful hypnotic, such as hyoscin.

If all other methods fail, it may finally be necessary to infiltrate the left phrenic nerve with novocain at the root of the neck.

Chest Complications. *Atelectasis* (collapse of the lung) is a common but not a serious complication. *Bronchitis* and *bronchopneumonia* may occur especially in elderly people after abdominal operations.

These complications can be reduced in frequency by proper pre- and post-operative care. Smoking should be prohibited for a month before operation. A cold in the head should cause the operation to be delayed. The anæsthesia should be conducted without cyanosis or respiratory embarrassment. After operation the pulmonary ventilation should be assisted by propping the patient up and by encouraging breathing exercises. In elderly persons subject to bronchitis, a mixture of oxygen and carbon dioxide may be given at intervals for a day or two after operation. Antibiotics are valuable in the treatment.

Thrombophlebitis. This condition affects most commonly the veins of the pelvis or lower limb. It occurs most often in middle-aged or elderly persons after an abdominal operation. It may lead to pulmonary embolism.

Retention of Urine. This may result from spasm after operations upon the perineum, hæmorrhoids, anal fissure, etc. It is also a fairly common complication in elderly persons, especially women, after any form of operation. In such cases the bladder is atonic and distends insidiously, reaching the umbilicus or higher in the abdomen; since a certain amount of urine is generally evacuated, the condition may escape recognition for several days and cause headache, dryness of the tongue, a rapid pulse, and even a low delirium, from incipient renal failure. The treatment is described on a later page.

Abdominal Complications. *Acute dilatation of the stomach, adynamic ileus, peritonitis, pelvic abscess, subphrenic abscess* and *wound disruption* are discussed in later chapters.

Parotitis. Acute infection of the parotid glands (generally bilateral) is an infrequent complication of operation. The features are described on p. 292.

Acidosis or Ketosis. The acid end products of metabolism are excreted by the lungs if volatile and by the kidneys if non volatile. Fatty acids are normally oxidised completely and excretion presents no difficulty; but in the absence of adequate carbohydrate metabolism oxidation stops at the toxic "ketone body" stage.

Apart from diabetes (below), the carbohydrate reserve is diminished most often as a result of starvation or vomiting, and ketosis then

develops Ketosis may occur also when the glycogen content of the liver is impaired or when the excretion of ketone bodies is diminished as a result of renal damage. Children, in whom the carbohydrate reserve normally is small are especially liable to ketosis.

The symptoms may come on slowly or be precipitated by some form of septic infection At first there is a sense of weakness and tiredness. *Nausea and vomiting are common and vomiting may be repeated* There may be abdominal pain accompanied in some cases by muscular rigidity

The diagnosis can be made by smelling acetone in the breath or by demonstrating its presence—or that of aceto-acetic acid—in the urine Examination of the blood shows a diminution of the carbon-dioxide combining power from the normal 55–80 vols. per cent., perhaps as low as 20

The treatment is to give alkalies with glucose and copious fluids. In severe cases glucose solution should be given intravenously If the ketosis is due, as is commonly so in post-operative cases, to vomiting associated with gastric dilatation, the stomach should be washed out.

Surgery and Hæmophilia

Until very recently the treatment of hæmophilic persons suffering from injuries or spontaneous hæmorrhage has posed one of the most difficult problems in surgery, while the dangers of post operative bleeding have been so great as to prohibit all forms of major operative inter



Fig. 4 Hæmatoma in hæmophilic boy at site of injury by splinter of glass.

vention This picture is now beginning to change, but even so the application of surgical treatment in hæmophilics must still only be considered where the need is grave and where modern methods of after care are available.

Hæmophilia is a sex linked inherited disorder occurring only in males but transmitted by females. Thus the daughter of a bleeder does not suffer from the disease but will transmit it to her sons. The son of a bleeder does not suffer from it and only rarely transmits it. It is now established that the excessive bleeding is due to lack of a globulin

normally concerned with clotting the anti hæmophilic globulin or A.H G

A hæmophilic person is liable to uncontrollable hæmorrhage after trifling injuries, such as a small wound or a tooth extraction He develops hæmorrhages in the joints (hæmarthrosis) leading to crippling arthritis. He bruises easily, forming large hæmatomas which may persist for months, may form cysts and may burst, becoming infected and leading to death from hæmorrhage Lastly, unless specially treated he will inevitably bleed to death after any major operation

Hitherto the only specific treatment available has been to transfuse fresh blood or plasma, but the results have been variable, for the reason that the missing globulin is very labile and is rapidly destroyed In recent years, however anti hæmophilic globulin has been prepared from ox or pig blood and these preparations are now becoming available for general use. They are given intravenously, in doses of about 300 mg daily which corresponds to the globulin content of 2½ litres of fresh blood

At the present time the globulin preparations are impure and contain proteins, so they are antigenic. After ten to fourteen daily injections they cause urticaria and rigors, and while these can be controlled by anti histamines they leave the patient liable to anaphylaxis. The globulin should therefore be reserved for times of real need.

In lesser hæmorrhage, repeated transfusion with fresh blood or plasma stored at — 30°C will often suffice. In addition particular care must be taken to immobilise the bleeding part and protect it from trauma.

Surgery and Diabetes

While formerly any operation upon a diabetic patient was fraught with danger now, with experience in the use of insulin operation carries little greater risk than in non-diabetics Moreover, the number of diabetic patients living has increased as a result of insulin therapy and operations are therefore required more often

Surgical treatment may be required for the usual indications, as in non-diabetics, and especially for the conditions to which diabetics are prone, namely —

(1) Acute sepsis, especially carbuncles.

(2) Obliterative vascular disorders, culminating in gangrene of the foot.

The special therapeutic problem is to prevent the onset of ketosis for this occurs much more readily than in non-diabetics.

Acidosis or Ketosis in Diabetes. This differs from the corresponding condition in non-diabetics (above) only in the ease with which it occurs.

Insulin deficiency—the cardinal feature in diabetes—impairs both the storage and utilisation of carbohydrate. The meagre carbohydrate reserve is then readily exhausted by starvation or vomiting or by liver damage from sepsis or the use of toxic anæsthetics, while the utilisation of carbohydrate is increased when the metabolic rate is raised in pyrexia.

The symptoms, which are similar to those in non-diabetic ketosis, are apt to develop rapidly especially when precipitated by some form of septic infection If untreated, ketosis in diabetics becomes rapidly severe and leads to coma and death.

Preparation of Diabetics for Operation. *Interval Cases* In interval cases it is only necessary to put the diabetes under control by the usual diabetic measures, and insulin if need be If the operation is of major character it is advisable to give 10–15 units of insulin subcutaneously a few hours earlier, backed by 20 grams of glucose intravenously

Emergency Cases In diabetic patients requiring emergency operation an acute septic condition is usually present, and ketosis is either present or threatened

In such cases energetic treatment is required by insulin, covered by sufficient glucose to avoid the risk of hypoglycæmia. It is found that 1 unit of insulin is covered adequately by 2 grams of glucose. In this way sufficient glucose will be metabolised to assure the complete combustion of the ketone bodies.

In the average case 20 units of insulin may be given subcutaneously and 40 grams of glucose in 6 per cent. solution intravenously before operation, and the same repeated every four hours after operation. The urine must be examined each time before the insulin is injected and if the urine is found to be sugar free the insulin should be stopped the glucose alone being given.

Post-operative Treatment. Where the diabetes is not severe, or the operation is of only moderate severity, it suffices to watch the urine and administer insulin, backed by glucose, as required. In more severe cases as much as 20 units of insulin may be needed four hourly with 40 grams of glucose intravenously to control the ketosis.

CHAPTER 2

HEALING AND REPAIR OF WOUNDS

A PROPER understanding of wound healing, and of the factors which accelerate or retard it, is clearly essential to surgeons, in whose work the treatment of wounds takes an important place.

The healing of wounds is influenced by many agencies, notably by the vascularity of the part, by the accuracy with which the wound margins can be co-apted, and by the presence of infection

It will be advisable first to consider the process of healing in clean wounds, and later to study the complicating features introduced by the presence of infection.

Healing of Clean Incised Wounds. If the margins of a clean incised wound are accurately co-apted *the process of healing takes place with*

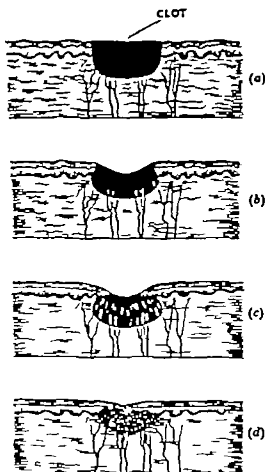


FIG. 5 Wound healing. (a) Fresh wound filled by blood clot, (b) capillary loops invading clot, (c) epithelial proliferation over surface of granulation tissue (d) contracted scar

remarkably little disturbance. Microscopic examination shows that the adjacent tissues present the signs of an aseptic inflammation the response of healthy tissue to trauma. Blood vessels dilate, the blood

flows sluggishly, fluid is poured out, containing antibodies, polymorphs and mononuclear phagocytes.

Following rapidly upon this inflammation comes the process of repair Young capillary vessels bud out from existing vessels at the margins of the wound and invade the coagulum occupying the wound Around the capillaries appear fibroblasts, and with them come large phagocytic endothelial cells, scavengers of dead material. The fibroblasts proliferating form young connective tissue among the capillary loops (granulation tissue) and this later develops into adult fibrous tissue, which contracts and ultimately forms a fine narrow scar

While these changes are taking place in the depths of the wound the basal cells of the epidermis also respond They proliferate and grow out over the granulation tissue to repair the surface defect with an epithelial layer which in the accurately co-apted wound, eventually approximates closely to normal skin

The rate of healing of clean incised wounds varies in different parts of the body Wounds in such vascular regions as the face heal quickly whereas wounds in less vascular regions, especially if subject to frequent movement, take much longer

Healing of Open Wounds. In clean wounds that are large and not co-apted, healing is delayed by the simple physical difficulty of filling

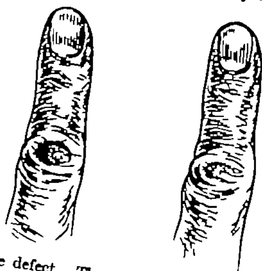


FIG. 6. Wound healing (a) Fresh wound of knuckle, (b) contracted healed scar

the defect. The same inflammatory reaction occurs, and the cavity of the wound is filled by a coagulum of blood and lymph, containing many leucocytes Capillary loops and fibroblasts grow into the coagulum from the surrounding tissues and sooner or later line the wound with granulation tissue.

While these changes are occurring in the depths of the wound the epithelium round the wound margin proliferates and grows over the defect, eventually covering it with a thin blue layer of epithelium If not anchored to underlying bone, an open wound contracts very markedly (Compare any ordinary wound with the size of the eventual scar) and this may enable even a large wound to heal But if the defect

is very large the process of epithelial ingrowth becomes progressively slower owing to lack of adequate nutrition from the underlying fibrous tissue and the centre of the wound may remain as an open ulcer In practise, such a development is prevented by early skin grafting which has the additional merit of reducing the risk of bacterial infection

Closed Wounds. Closed or subcutaneous wounds are those in which the skin remains intact. They may be due to blows with blunt objects to falls from a height to crush injuries and similar types of trauma They include injuries to the soft parts and fractures They vary from a simple bruise to the formation of a hæmatoma or to a major injury with widespread interstitial hæmorrhage, which may be associated with considerable shock.

Treatment of Wounds

In the immediate treatment of contaminated wounds the primary aims are to obviate infection and to put the affected part under the conditions most favourable for healing The treatment must be prompt, for within a few hours such organisms as have gained access to the wound proliferate in the devitalised tissue and spread into the neighbouring intercellular spaces.

Formerly the "safe period" for immediate wound treatment was six to eight hours, but by administration of antibiotics it may be increased to twelve or even twenty four hours.

The first step is to cleanse the wound thoroughly enlarging it if necessary to gain access to its deeper parts. Grossly soiled and devitalised tissues are then excised (débridement) When adequate cleansing has been achieved the wound is closed, or if much skin has been lost, a graft may be applied to cover the raw surface. Whenever possible the limb should be immobilised by splintage. When infection is feared an antibiotic should be given, locally and parenterally Indeed, in all major wounds of such important members as the hand and fingers, it should be given as a routine. In special cases tetanus anti serum should be given.

Cleansing the Wound In all but the most trivial wounds general anæsthesia is strongly advisable A tourniquet is helpful if the wound is in a limb

If the wound is in a hairy part, the surrounding skin must be shaved A sharp razor is essential It should be drawn parallel to the wound the raw area being protected by a swab Thorough cleansing of the skin is now required, preferably by several changes of soap and water applied with a nail brush At this stage if desired an antiseptic may be applied to the skin, such as iodine, Cetavlon or Hibitane

The wound must now be cleansed all foreign matter is removed, and if the wound is deep all intermuscular pockets opened up and cleaned If the wound is oblique or punctured or deeply penetrating the skin must be incised up and down the limb as far as necessary to gain access to all parts. Cleansing the wound should be thorough and may occupy ten minutes or more.

Débridement. Formerly wide excision of traumatised tissues was thought necessary but by thorough cleansing and the use of antibiotics it is no longer so However, all grossly devitalised tissue should be snipped away and loose tags of tissue trimmed off The skin is especially vulnerable. A flap of skin, partly avulsed, greyish or blanched and not bleeding should be removed, and the wound covered with a skin graft.

Closing the Wound. Formerly if a wound were grossly contaminated and likely to go septic it was left open to heal by "second intention" With modern methods and the use of antibiotics this method is no longer necessary On the contrary every attempt is made to close the wound or to cover it by a skin graft, thus enhancing rapid healing and avoiding secondary contamination. An open wound is an anachronism. The methods of skin grafting are considered on p 57

Immobilisation of the Affected Part. If the wound is put completely at rest pain rapidly diminishes, the natural defence reaction is assisted and healing accelerated This principle, long established in the case of fractures, is now accepted for wounds of all tissues The immobilisation is best achieved by plaster of Paris Alternatively fixation may be by a splint. Care must be taken to maintain the function of the joints, as described in the chapter on fractures The part should be bandaged firmly and elevated to prevent œdema.

Preventing Secondary Infection. It is now recognised that delayed sepsis is often due to secondary infection either by air borne organisms or from faulty dressing technique. Frequent dressings should be avoided, and often the first dressing may be delayed for five to seven days or longer A rigid aseptic dressing technique must be observed. To obviate air borne infection all bed making and other ward activities should cease an hour before the dressing round, and dressers and nurses should wear caps and gowns and masks. The actual dressing is carried out by a no touch technique to avoid case-to-case contamination.

Treatment of Septic Wounds. A recent wound, showing local evidence of inflammation or giving rise to the constitutional signs of infection, should be opened up if necessary by removal of stitches, to allow free exit for any infective fluids, and hot fomentations should be applied. In mild infections this may suffice.

If signs of abscess formation appear it may be necessary to probe the wound with a pair of sinus forceps, or to make fresh incisions to let out any pus. If deep wound infection occurs, it may be necessary to throw the whole length of the wound open and to institute treatment for cellulitis (p 22)

Treatment of Granulating Wounds. When the infection has been overcome and the wound, its edges perhaps widely separated is lined by granulation tissue, the main indication is to hasten the growth of epithelium over the surface. If sufficient soft tissue is available, secondary suture may be carried out, the skin margins being undercut sufficiently to permit of their being brought together and held by strong deeply placed sutures of silkworm gut. Alternatively skin

grafts should be applied without delay to obviate the risk of scarring and contraction These secondary procedures should be carried out under antibiotic cover

Special Types of Wounds

Incised wounds result from injury by knives, glass splinters or other sharp missiles. They bleed freely, but generally are but little contaminated and heal well after primary cleansing and excision

Contusions or bruises are wounds of the deeper tissues unaccompanied by solution of skin continuity They are generally aseptic, and their main effects are due to extravasation of blood from ruptured vessels The resulting swelling may be large or small according to the amount of damage and the laxity of the tissues affected The extravasated blood may remain bright red if situated under a thin membrane such as the conjunctiva, which permits oxygenation In other situations it changes first to blue-black from loss of oxygen later through the stages of brown, green and yellow as the blood pigment is disintegrated Complete absorption of the extravasated blood may be achieved in from a few days to a few weeks. In some cases a hæmatoma persists It may lead to the formation of a cyst or may become infected and suppurate.

The treatment of a bruise is well known The part should be immobilised and elevated, elastic pressure should be applied to diminish the swelling, while cold applications and local anodynes such as lead lotion may be tried Subsequently the œdema may be dissipated by gentle massage.

Punctured wounds are generally caused by small objects penetrating the skin from without. They cause little external bleeding but may lead to the development of a large deep hæmatoma. Foreign material, often contaminated, may be introduced and cause serious wound infection. This is the type of injury particularly prone to lead to tetanus or gas gangrene.

The treatment consists in exposing the depths of the wound carefully after extending the skin incision and in carrying out a primary excision of the wound whenever possible.

Contused or lacerated wounds are caused by blunt instruments, or by dragging or tearing, for example, in machinery accidents Such a wound has irregular ragged edges, and much skin may be lost. Hæmorrhage is often slight, but the deeper parts are often grossly contaminated by ingrained dirt.

The treatment consists in thorough primary excision of all damaged tissues. Often it is not possible to close the skin gap in these cases and skin grafting may subsequently be required.

Dog bites should be treated like other punctured wounds (see above) In Britain, no further treatment is required but in countries where rabies occurs prophylactic measures against hydrophobia should be taken.

CHAPTER 3

WOUND INFECTIONS

ACCIDENTAL wounds are generally contaminated but by early thorough treatment the bacteria can usually be eliminated so that wound infection does not follow Operation wounds fall into three classes, those presumably uncontaminated—nearly all clean operations—those possibly contaminated to a mild degree, such as operations on the abdominal viscera, and those inevitably contaminated, for example the opening of abscesses. Any operation wound may, however become infected by mischance through some failure in theatre ritual or subsequently from cross infection in the ward To assess and prevent such mishaps, a *Ward Book* should be kept, in which every operation wound is recorded, and any infection noted Any infected wound should be submitted to bacterial culture, and the organisms classified Staphylococci, the common offenders, should be coagulase-typed and phage-typed, for if several of the same type are isolated a common source may be presumed.

The manifestations of bacterial infection—inflammation, suppuration, and the repair process—are not, of course, exclusively seen as complications of open wounds. They may follow infection through minute punctures or along hair follicles, or they may be due to blood borne organisms. For convenience, however they are described in this chapter

ACUTE INFLAMMATION

When pyogenic organisms invade the tissues, their toxins evoke the tissue reactions known as inflammation The blood vessels adjacent to the wound become dilated, and render the surrounding skin and tissues red and hot fluid exudes from the dilated vessels and leads to swelling and inflammatory œdema the sensory nerves of the affected region, irritated by the toxins and compressed by the œdema, give rise to pain, often of a throbbing character· finally nerves, muscles, joints and glands lying within the inflamed area all suffer some impairment of their functional capacity Thus originate the five cardinal signs of inflammation—rubor calor tumor dolor functio læsa.

A superficial inflammation is readily recognised. The skin is red, and hot to the touch. The part is swollen and tense. Pain is felt locally especially on movement, and there is exquisite tenderness on pressure or even on light touch.

A deep inflammation in the early stages gives rise merely to pain and to tenderness on deep pressure. In some situations—for example, in the abdomen—inflammation leads to reflex rigidity of the covering

muscles As the inflammation spreads more superficially, increasing tenderness and superficial œdema may be observed

Treatment. The patient should be nursed in bed under the best available hygienic conditions Adequate sleep must be ensured by the administration of drugs of the barbitone series by chloral and bromide, or if necessary by opiates. Antibiotics are administered

The administration of fluids is of prime importance to combat dehydration Water, orange juice, diluted milk, barley water or similar bland fluids should be given in large amount In more severe infections intravenous infusion is required

The inflamed part should be immobilised and elevated This eases *the pain and diminishes the inflammatory œdema* The application of heat is soothing Fomentations and poultices are much used for this purpose, but they lose their heat rapidly and moreover tend to make the skin sodden An electric heater or pad is often preferable, or failing that a hot bottle. *Applications such as ichthyol and glycerine, lead and* opium, etc. are valueless.

ACUTE ABSCESS FORMATION

Acute abscess formation results when there is a nice balance between the infection on the one hand and the tissue reaction on the other The combined effects of antibodies and phagocytes have circumscribed the infection, yet failed to destroy the causative organisms Many of the phagocytes are themselves destroyed by the bacterial toxins, and they or their liquefaction products are the main constituents of the pus. In severe spreading inflammations the appearance of pus indicates that the infection is becoming circumscribed hence the old term laudable pus "

A small collection of pus may in time be absorbed if the infecting organisms succumb Otherwise an abscess tends to increase in size, to spread along the lines of least resistance, and ultimately to point at the skin surface or into a hollow viscus.

After rupture or after surgical drainage an acute abscess tends to heal rapidly unless the infection is maintained by the presence of a foreign body or a persistent focus of infection.

Treatment. The constitutional treatment of inflammation is continued Locally the essential treatment is to let out the pus and to provide adequate drainage until healing is assured.

A superficial abscess is opened widely and packed loosely with sterile gauze A deep-seated abscess, on the other hand requires a planned incision to gain access, and after being opened should be drained for a week or so until the discharge lessens. Drainage may be provided by a strip of dental rubber (rubber dam) but if the wound of access tends to be valvular a stiff rubber or polythene tube is preferable. The drain is withdrawn by stages and cut short before it is finally removed For large abscesses multiple drains may be necessary preferably inserted through counter incisions planned to give dependent drainage.

Deep-seated abscesses lying under cover of important structures should be opened by Hilton's method. A small incision is made through the skin and superficial tissues, and a blunt probe is passed deeply into the abscess. A pair of sinus forceps is then inserted along the probe and opened so as to dilate the track sufficiently for the introduction of a drain. In this way damage to the overlying structures is avoided.

Special abscesses, such as brain abscess, appendix abscess and subphrenic abscess, are described in the appropriate chapters.

CELLULITIS

This is an acute diffuse inflammatory process affecting the subcutaneous tissues and other lax connective tissue planes. It is characterised by extensive necrosis or sloughing of the tissues, with scanty pus-formation as a later and secondary feature. The infecting organism is generally the *Streptococcus hæmolyticus*.

Cellulitis may follow a trivial cut or abrasion. The onset may be sudden and severe, with high temperature, rigors and marked toxæmia.

The affected part is swollen and brawny and all the local signs of inflammation are present. In the early stages there may be marked lymphangitis, with scarlet coloration and intense tenderness of the skin, but without the definite raised margin characteristic of erysipelas. Later the skin is transparent and shiny whilst the deeper tissues are œdematous and boggy. Eventually the skin becomes discoloured and may separate, revealing grey necrotic sloughs beneath.

Treatment. The constitutional treatment for inflammation should be instituted. Antibiotics are given and an intravenous infusion set up. The part should be immobilised and elevated and "baked." If the infection does not subside, and pus formation becomes evident, the part should be incised.

Cellulitis in special regions—the scalp, the orbit, the neck, the hand, the pelvis, the perineum and the scrotum—is described in the appropriate chapters.

SEPTICÆMIA AND PYÆMIA

These closely related diseases, formerly common and dangerous complications of wound infections are now rare and readily controlled. Septicæmia implied invasion of the blood stream by organisms particularly of the pyogenic group; pyæmia was thought to be due to the access of pus to the blood stream and was characterised by the development of metastatic abscesses.

Formerly hæmolytic streptococci were the common offenders. Now antibiotic resistant staphylococci are taking their place.

The clinical features are those of a severe infection with pyrexia, rapid pulse rate, and rapid breathing. There is marked malaise, and there may be delirium.

Diagnosis. A blood culture forms the essential diagnostic procedure. A syringeful of blood (10 to 20 ml.) is withdrawn from a vein and added to 100 or 200 ml. of broth which is then incubated. If no growth is obtained the test should be repeated, preferably when the temperature is rising after a rigor.

Treatment If the infecting organism is sensitive to any type of antibiotic the treatment is to administer it in large doses, and a quick response is usual The real problem is when the organism usually a staphylococcus, is *completely antibiotic-resistant* Reliance must then be placed on supportive therapy, that is careful nursing adequate fluids and similar measures The outlook is poor

GAS GANGRENE

This disease formerly a dangerous one results from infection of a wound by various anaerobes especially *Cl Welchii Cl septique* and *Cl. œdematiens*

Predisposing Factors The organisms of gas gangrene are intestinal saprophytes and are found in immense numbers in animal excretions Gas gangrene is therefore common in wounds of the lower limb contaminated with soil or manure. In such wounds gas gangrene is most likely to supervene (1) if the wound is small and valvular or sealed early by blood clot or a tight bandage (2) if there is much damage to muscles; (3) if the blood supply is impaired (4) if a foreign body is buried in the part.

Pathological Features All the organisms of gas gangrene have a powerful toxic action on muscle tissue and spread rapidly to infect the whole length of the muscle bellies involved. Being all either saccharolytic or proteolytic they break up the muscle sugars and proteins and liberate gases including carbon dioxide hydrogen and hydrogen sulphide. Being strongly hæmolytic they produce a brick-red discoloration of the affected muscles and rapidly cause marked anæmia. Being highly toxic, they inhibit all reactive processes including leucocytosis and bring about a rapidly fatal issue.

Types of Gas Gangrene. (1) Anaerobic cellulitis is a relatively mild form in which the infection is limited to the subcutaneous tissues or perhaps the intermuscular connective tissues. A similar lesion may be caused by anaerobic gas-producing streptococci. The wound is dirty and malodorous but there is little gangrene and the symptoms are comparatively mild. The treatment *is to open the wound widely to permit free drainage and to give penicillin in full doses*

(2) Clostridial myositis or true gas gangrene may affect a single muscle or muscle group or a whole limb The disease spreads rapidly from end to end of the affected muscles particularly if the blood supply to the limb is impaired. Sometimes it spreads with appalling rapidity and, if untreated it may cause death within a few hours

The symptoms generally start within a few hours after the injury with pain and numbness in the wound and rapid severe toxæmia. The wound looks pale and lifeless, with profuse watery discharge, which contains bubbles of gas The treatment is to give penicillin in full doses and other measures as for other severe infections No other treatment is usually required. In former days it was often necessary to perform an urgent amputation and even this often failed to arrest the progress of the disease. Fortunately however the organisms are very sensitive to penicillin and this or other antibiotics are quickly effective.

ERYSIPELAS

Erysipelas (Greek: *Ερυθρός* red; πέλλα, skin) is a spreading infection of the skin by hæmolytic streptococci. It may affect the face, starting near the mouth or nose, or it may originate in a wound. The affected skin is smooth, tense and fiery red hot to the touch and acutely tender The spreading edge is palpably raised and may be marked by vesicles The regional glands are enlarged and tender

The constitutional reaction may be slight, or there may be severe effects,

with high temperature and marked toxæmia. If untreated the disease may prove fatal.

Fortunately the streptococcus of erysipelas is sensitive to penicillin and under this treatment the disease is quickly arrested. Its surgical importance is in consequence much less than formerly

TETANUS

The tetanus bacillus is a Gram positive slender rod shaped organism often with a drumstick shape *owing to the presence of a terminal spore* It is very resistant to antiseptics, and the spores may survive boiling for fifteen minutes or even longer

The bacillus is a normal inhabitant of the intestines of the horse, the ox, and occasionally of man consequently tetanus is apt to follow wounds contaminated by fæcal matter or manured soil Since the bacillus is a strict anaerobe, tetanus is most likely to follow deep punctured wounds especially if there is much necrosis or if a foreign body is embedded It may arise, however from a superficial wound or even an abrasion if air is excluded by a covering scab

The bacillus is a saprophyte and does not invade the tissues or the blood stream consequently the symptoms are due entirely to toxins absorbed from the wound The main effect of the toxins is to increase the conductivity of the synapses in the anterior horns of the spinal cord and the motor nuclei of the brain As a result the motor nerve cells respond in a greatly exaggerated fashion to the slightest stimulus and send out impulses which lead to violent muscle spasms.

The route of absorption of the toxin from an infected wound is not clear The older view was that the toxin spread from the wound to the brain or cord by way of the perineural spaces of the motor nerves and on this hypothesis it was thought that the toxin could best be neutralised by injecting antitoxin either directly into the region of the wound or intrathecally Recent work, however seems to indicate that the toxin is absorbed from the wound into the blood stream and reaches the nervous system by this route from which it would appear that the rational method for administering antitoxin is by the intravenous route.

Incubation Period and Prognosis. The prognosis depends to a large extent upon the incubation period. This period varies from three days to thirty days or more, with an average of ten days. In those cases where it is less than ten days the risk is great. The longer the incubation period the better the prognosis. Incubation periods of longer than three weeks occur mainly in those who have been partially protected by prophylactic injections of serum, and in such cases the prognosis is favourable. The period of onset, the interval between the first symptom and the first generalised spasms, is also a useful prognostic index If this period is longer than two days, recovery is usual.

Symptoms. Generally the first sign is stiffness of the jaw muscles (trismus) This limits opening the mouth, and the patient eats by sucking up semi-solid food. Exaggeration of the knee-jerks renders the

gait rather clumsy There is some stiffness in the back Malaise is slight, and at this stage the victim may not realise that anything is amiss

The first spasm comes unheralded There is sudden tearing pain in the back lasting perhaps five or ten seconds Soon the spasms become generalised and every muscle contracts to its utmost, the contraction being maintained as long as the spasm lasts The back arches, for the extensors overcome the flexors. The lips are drawn back in an unnatural grin (*risus sardonicus*) Breathing is arrested and it is impossible even



FIG. 7 Tetanus: Risus Sardonicus.

to cry out. So powerful are the spasms that muscles may be ripped from their attachments or bones fractured: the agony beggars description Swallowing may be impossible during the first day or two and thirst adds its torment. The mind is hyperacute, and the whole attention is focused on dread of the next spasm.

Prophylaxis. Active immunisation with toxoid is now given combined with diphtheria toxoid for young children, and is also the rule in the armed services. A booster dose is advisable every ten years and also at the time of any injury In such persons immunity is complete. In non immunised patients admitted with contaminated wounds passive immunisation may be induced by 1 500 units of antiserum subcutaneously In view of the risk of anaphylaxis it is generally restricted to cases with punctured wounds or devitalised wounds heavily infected or contaminated with soil or manure.

Treatment. Antitoxin and antibiotics will control the infection but the toxin already fixed in the central nervous system imperils life by continued spasms. It is therefore necessary to give relaxants and sedatives for as long as two or three weeks, while maintaining respiration preventing pulmonary infection and supplying food and fluids

Under heavy sedation, tetanus antitoxin is given in large amount intravenously say 100 000 units repeated for two or three days. Penicillin 500,000 units, is given six hourly When this has been done the wound is opened or excised.

As relaxants, drugs acting centrally may be used, such as chlorpromazine or thiopentone or ganglion blocking drugs of the curare

groups or Mephanesin (Myanesin) which reduces muscle tone without marked interference with respiratory or voluntary movements. Mephanesin is given by continuous intravenous drip through a polythene tube, as 0 4 per cent. solution in glucose saline adjusting the flow sufficiently to prevent spasms. Additional sedation may be needed

Artificial respiration is needed, especially with ganglion blocking agents. An oxygen air or oxygen nitrogen mixture may be given by intratracheal tube using an anæsthetic machine. Many surgeons advocate tracheotomy to prevent stagnation of bronchial secretions and to enable them to be aspirated more readily

Food must be given by stomach tube. A high calorie intake is needed since the calorie requirements are greatly increased by the spasms Additional fluids and electrolytes must be given intravenously since often there is much sweating This treatment must be continued for a long time, perhaps two weeks or even three.

ANTHRAX

The anthrax bacillus, a large, Gram-positive spore-forming organism gives rise in animals to a highly fatal septicæmia known as splenic fever Man is infected either directly through contact with a diseased animal, or much more often indirectly from infected hides or wool or hair

Three forms of the disease occur in man. All are rare

Woolsorters Disease, a virulent form of pneumonia, due to inhalation of the organism by those working with raw wool or hair *Intestinal Anthrax* a gastro-enteritis due to ingestion of infected meat. *Malignant Pustule*, due to inoculation of a skin abrasion with organisms from infected hides or wool or hair This condition generally occurs as an occupational disease in hide porters and dock labourers and others engaged in the transport of raw hides

The pustule occurs most often on the hand or arm and is characterised by central black necrosis of the skin with marked local œdema and enlargement of the regional lymph nodes. It may be diagnosed by microscopic examination of fluid from a pustule in which the bacillus can readily be identified

The essential part of the treatment is to administer Sclavo's serum produced by injecting massive doses of the organisms into goats or asses

CHAPTER 4

ACTINOMYCOSIS

Actinomycosis is a chronic granulomatous disease of soft tissue, resulting from infection by the *Streptothrix actinomyces* It is characterised by the formation of an indurated swelling which spreads slowly, softens and forms multiple sinuses

The infection generally gains access at the root of a carious tooth or through a tonsillar crypt, and spreads to involve the jaw, cheek neck, and perhaps the tongue. Occasionally the disease appears in the abdomen or in the lung It may spread by the blood stream and form metastases in other tissues



Fig 8. Actinomycosis of the Jaw

Formerly actinomycosis was regarded as a disease of farmers, stable-workers and corn dealers, and was believed to be carried in grains of corn or fragments of straw from cases of bovine or equine actinomycosis It is now known, however to be common in townspeople, and almost as common in women as in men and it is thought to be due to infection by saprophytic organisms frequently present in the mouth and throat, an entirely different organism from that which occurs in cattle. The factors that predispose to such infection are not understood

The streptothrix, which may be found in the tissues or in the discharge from the sinuses, forms minute granules, commonly described as " sulphur granules, but more often of greyish-green colour If such a granule is gently squeezed between a cover slip and a slide, it is seen to consist of an amorphous Gram negative mass from which radiate

intertwining Gram positive branching filaments. Some of the filaments may be broken up and appear as small, Gram-positive cocci, while occasionally at the periphery of the mass there are numbers of Gram-negative club-shaped processes.

Actinomycosis of the Neck and Jaw The infection gains access at the root of a carious tooth or through a tonsillar crypt or an abrasion of the oral mucous membrane, and gives rise to a slowly progressive painless swelling close to the jaw Later the skin breaks down forming multiple sinuses which discharge a thin, viscid pus, in which the grey green ' sulphur granules " may sometimes be distinguished

The diagnosis has to be made from chronic osteomyelitis, due to an infected tooth. Difficulty in diagnosis is most apt to occur in the early stages Later the characteristic appearance of much induration and multiple sinuses leaves little doubt, and confirmation can generally be obtained by microscopic examination of the discharge.

Actinomycosis of the Lung This affection may occur primarily or be secondary to disease of the jaw or neck. The lung becomes infiltrated with fibrous tissue, and excavated by cavities. Later the disease invades the pleuræ, giving rise to adhesions and sometimes to empyema, and eventually may penetrate the chest wall or spread through the diaphragm and track within the abdomen.

Actinomycosis of the Abdominal Organs. The ileo-cæcal region is involved most often and doubtless is infected by swallowed streptothrices. An indurated mass forms in the right lower quadrant of the abdomen and spreads, adhering to and later infiltrating the abdominal wall or the kidney bladder or small intestine. Multiple sinuses form, and often a fæcal fistula develops. Occasionally actinomycosis appears in the liver following spread from the ileo-cæcal region

The symptoms at first are ill-defined, with loss of weight, anæmia, and occasional pyrexia. Later a hard mass becomes palpable in the abdomen, and still later the appearance of sinuses makes the diagnosis clear In some cases at an early stage there are symptoms suggestive of a subacute attack of appendicitis

Treatment of Actinomycosis

Penicillin in full doses sometimes achieves a complete cure. If it proves ineffective, other antibiotics should be tried. In resistant cases X ray therapy is valuable. Potassium iodide is sometimes effective The dose is raised progressively up to 120 grains daily and then reduced, the whole course occupying two to three months. Operative exposure and drainage of abscess cavities with excision of scar tissue and curettage of sinuses are helpful.

CHAPTER 5

TUBERCULOSIS

INFECTION by tubercle bacilli may result from inhalation of droplets or dried particles of sputum from a phthisical patient or from ingestion of infected material especially milk from cows with tuberculosis of the udder

After being inhaled or ingested the organisms usually gain access to the tissues in one of three regions (1) the pharynx and tonsils (2) the bronchi and lungs (3) the distal ileum Generally, no evident lesion develops at the site of entrance and the organisms at once gain access to the lymphatics and are carried to the regional glands—cervical, broncho-mediastinal or ileo-cæcal

This constitutes the first stage of infection the stage of tuberculisation It occurs most commonly in children between the ages of three and ten years In the majority of cases the disease progresses no further the infected glands become fibrous and perhaps calcified and the child continues to thrive In the minority of cases, when later the general resistance is reduced by some intercurrent disease, the tuberculous infection may flare up It then spreads and gives rise to tuberculous lesions in other parts of the body

The Tuberculous Lesion

In whatever tissue they lodge, tubercle bacilli evoke a special type of tissue reaction characterised by the formation of a tubercle or tuberculous follicle Such a follicle consists at first mainly of aggregations of lymphocytes and endothelial cells. Giant cells, containing multiple nuclei usually disposed in horse-shoe fashion, are generally but not invariably present. As the follicle enlarges and merges with adjoining ones the central cells suffer from lack of blood supply and from the action of the tuberculous toxins, and undergo necrosis to form the cheesy material known as caseous matter At this stage the infection may subside and the follicles become imbededd in fibrous tissue which may subsequently become calcified

Tuberculous Abscess. Cold Abscess. On the other hand the disease may progress, and the caseous matter become liquefied and purulent, constituting a tuberculous abscess or cold abscess. Such an abscess tends to spread along the line of least resistance and eventually may open at the skin surface or into a viscus, forming a tuberculous sinus. The abscess may pocket in the different tissue planes, and may track a long way before reaching the surface.

A cold abscess gives rise to few or no symptoms, unless secondarily infected

On examination a cold abscess may be recognised as a swelling which is rounded and elastic if the pus is under tension, but may be soft and lax in other cases. Fluctuation can generally be elicited (Fig 9) even if the abscess is deep seated.

The skin becomes stretched and shiny as the abscess approaches the surface. Later it assumes a purplish colour, and finally breaks down forming a sinus. There is no local increase in temperature (hence the



FIG 9 Tuberculous abscess. This soft painless swelling was the first indication of a tuberculous periostitis of the spine. The illustration shows the method of testing for fluctuation. The fluid character of the swelling in this case is evident.

name cold abscess) nor is there any redness or congestion. There is neither pain nor tenderness, even on deep pressure.

Tuberculous Sinus. A sinus arises, as described above, when a cold abscess opens at an epithelial surface, generally the skin. Usually therefore, a sinus communicates, by a tortuous channel, with a diseased bone, gland or other focus.

A tuberculous sinus must be diagnosed from other chronic sinuses, most of which owe their existence to the presence of a foreign body or some necrotic tissue such as a bone sequestrum. To determine the origin and extent of the sinus a radiographic examination should be made after injection of 10 to 20 ml. of Lipiodol

Tuberculous Ulcer A tuberculous ulcer nearly always occurs as a result of the breaking-down of a superficial glandular or other tuberculous focus. The ulcer is flat and superficial, and may be of considerable size. Its floor is covered with pale granulations, and it has a thin, bluish, undermined epithelial edge. As diagnostic measures, the discharge from the ulcer may be examined microscopically, or better a portion of the edge of the ulcer may be removed for histological examination.



FIG. 10 Tuberculous ulcer due to rupture of a cold abscess originating in a focus at the lower end of the radius. The pale granulations and discoloured, undermined edges are evident.

Treatment of Tuberculosis

The treatment of tuberculosis has been revolutionised in recent years. Streptomycin, usually in combination with para amino-salicylic acid and/or iso-nicotinic acid is generally effective in arresting the infective process particularly when combined with good nursing care and an adequate dietary Surgical treatment may be required however in resistant cases Sometimes it is possible by operation to remove the diseased organ for example a kidney most often the aim of operation is simply to remove dead tissue, caseous matter and pus, in order to hasten the healing process

CHAPTER 6

THE VENEREAL DISEASES

SYPHILIS

THIS disappearing* disease is caused by the *Spirochæta pallida* (*Treponema pallidum*) a delicate spirillum of regular corkscrew shape It is generally a little longer than the diameter of a red blood cell and is actively motile. It is stained with difficulty but can be demonstrated readily by the method of dark-ground illumination, when it is seen as a pallid dead white spiral moving in characteristic fashion against the black background

The clinical course of acquired syphilis is generally described as consisting of three stages, which are more or less distinct In addition there is syphilitic disease of the nervous system, which is responsible for general paralysis of the insane and tabes dorsalis This latter condition gives rise to disturbance of micturition to neuropathic lesions of joints and to perforating ulcers of the foot.

(1) The primary sore in the genital region usually appears from fourteen to forty days after the time of infection arising painlessly and *forming a button like papule of rubbery induration which breaks down to* form an ulcer The regional lymph nodes in the groins become enlarged Spirochætes can be demonstrated either in smears from the primary lesion or in fluid aspirated from a lymph node.

(2) The secondary stage starts from six to twelve weeks after the time of infection and continues for a year or two with skin lesions such as a rash like measles or a papular eruption on moistare as such as the perineum lesions of mucous membrance, forming grey sodden patches, *especially within the mouth and painful nodules in the periosteum,* especially over the tibia.

(3) Tertiary lesions may occur at any time after about two years from the primary infection or even as early as one year from that date

The common tertiary lesions are —

(a) Affections of blood vessels, such as endarteritis and aneurysm

(b) Affections of the central nervous system, such as tabes dorsalis (locomotor ataxia) and general paralysis of the insane.

(c) *Gummata.* These are rubbery masses of tissue produced as a reaction to the presence of spirochætes. Microscopically there are endothelial cells and lymphocytes with giant cells similar to those found in tuberculosis, and a surrounding zone of fibrous tissue. Caseation may occur and, in addition, there is a marked degree of endarteritis in the vessels close by

* But some fear that with the development of resistant strain both syphilis and gonorrhœa may resume their former importance.



FIG. 11 Secondary stage of syphilis. Extensive papular eruption.



FIG. 12. Tertiary syphilitic ulceration of leg The ulcers, of circular shape, have "punched out" margins and are obviously indurated. Note the scarring and pigmentation of both legs.



Fig. 13 Tertiary stage of syphilis. A gumma in the lumbar region with a gummatous ulcer of typical appearance over the scapula.

A gumma may occur in any part of the body in the skin, mucous membranes, muscles, bones and viscera. It forms a painless lump which enlarges steadily in the course of a number of weeks and may attain considerable size Gummata of the skin readily ulcerate, as do gummata of the tongue. With appropriate treatment a gumma will disappear completely in three or four weeks.

GONORRHŒA

This disappearing disease starts as an acute urethritis and runs an acute course lasting two or three weeks. If untreated, it may spread to the posterior urethra, prostate, vesicles and epididymis. It may infect the blood stream, causing metastatic infection of joints, tendon sheaths, ligaments and other structures.

The symptoms of gonorrhœa appear from two to eight days after exposure to infection. The first symptom is a scalding pain in the urethra on micturition There may be painful erections Then a urethral discharge appears at first watery later purulent, and leaks from the external meatus independently of micturition. On examination the mucous membrane at the external meatus is everted, swollen and acutely inflamed.

If the posterior urethra and prostate become infected there is urgent micturition, and sometimes terminal hæmaturia. There is pain above the pubes and in the perineum, or referred to the tip of the penis

The temperature is raised and there is considerable malaise Rectal examination reveals the prostate swollen and very tender

A *prostatic abscess* may follow The temperature is then raised to 102 or 104°F, the pain is severe and of throbbing character, and retention of urine may develop Rectal examination reveals the prostate large, tense and tender

The treatment of gonorrhœa has been revolutionised by the introduction of antibiotics, to which the gonococcus is highly sensitive Penicillin generally brings about a rapid and complete cure

CHAPTER 7

SHOCK AND HÆMORRHAGE

SHOCK

SHOCK is a common complication of severe injuries such as industrial accidents, road smashes and war wounds. It occurs most readily and is most severe in patients debilitated by excessive sweating vomiting or diarrhœa. The degree of shock is often increased by hæmorrhage.

There are two types of shock. *Primary shock* comes on at once after the injury and is a form of syncope, due to paralysis of the vasomotor centre under the influence of painful or other sensory stimuli. It is seen especially in blows on the solar plexus or injuries to the testis. It is generally transient and rarely dangerous.

Secondary shock comes on later usually within an hour or so occasionally after a lapse of several hours. It may be severe and even fatal. The following account applies to this type of shock.

Pathological Features. Shock is due primarily to reduction in the volume of the circulating fluid. Simple blood loss is the commonest form of shock—external hæmorrhage from a wound, hæmorrhage into the stomach from a peptic ulcer hæmorrhage into the peritoneal cavity from a ruptured spleen and so on. Another form of blood loss is seen in severe crush injuries, where blood is extravasated into the affected part. In an injury of the fleshy part of the thigh, for example, as much as 25 per cent. of the total blood volume may thus be withdrawn from the circulation.

In other cases, shock is caused by withdrawal of water and electrolytes. This is seen in any condition characterised by severe vomiting or diarrhœa, and it may of course, be aggravated by a reduced intake of fluids or by sweating. The shock of intestinal obstruction, of peritonitis, and of dysentery falls into this category.

Lastly shock may be caused by withdrawal of plasma from the circulating fluid. This occurs in burns from loss of blister fluid and exudation of plasma into the damaged tissues.

These different types of fluid loss have their own particular effects, but in all of them the main immediate results are due to the reduction in blood volume.

If the reduction in blood volume is not marked, it is compensated by reflex constriction of peripheral vessels, especially the arterioles and veins, which has the effect of reducing the total capacity of the vascular bed. This vasoconstriction is seen most markedly in the skin, which becomes white and bloodless. The constriction of veins becomes evident when a transfusion is given for the veins are of small calibre and difficult to cannulate, and after the needle has been inserted it may be

necessary to transfuse under pressure in order to overcome the venous spasm

If the reduced blood volume is not compensated in this way, the blood pressure falls, and this leads, among other effects to impaired blood flow through, and anoxia of such vital tissues as the brain liver adrenals, kidneys and myocardium It is this anoxia which, if continued, leads to the state known as *irreversible shock*. In this state, in addition to the parenchymal damage just mentioned the endothelial cells of capillary vessels in all parts of the body suffer from anoxia and become increasingly permeable, so that fluid leaks out into the tissue spaces and the volume of blood in circulation suffers a further reduction

Symptoms. In the early stages of secondary shock the patient feels cold restless and thirsty The temperature is subnormal and the pulse rapid. Later he is collapsed, conscious but apathetic, of ashen grey colour and with a cold clammy sweat. Respiration is shallow and the pulse is rapid and thready

Assessing the Degree of Shock. In shock it is unwise to prognosticate. A patient seen shortly after injury may appear to be in fair condition, yet succumb in a few hours to rapidly progressive shock. On the other hand, even a profound degree of shock such as is seen occasionally after a major operation may respond rapidly to treatment. The most reliable criterion is the blood pressure. In severe shock the blood pressure falls to 60 mm Hg or even lower and it is generally said that if it persists below 80 mm. for more than a short time the prognosis is grave.

Treatment. The patient is put to bed with the head lowered and the foot of the bed raised. Morphia is generally regarded as valuable, and many surgeons advise large doses—say gr ¼ for an adult.

In mild cases these simple measures may suffice. If the shock is more severe the essential treatment is to restore the volume of blood in active circulation In hæmorrhagic shock whole blood is used. Four or five pints may be required. It may be given rapidly provided that the neck veins are not filled (a warning of right heart dilatation) In shock from other causes, plasma is to be preferred or the appropriate electrolyte solution.

It is hardly necessary to add that the injury responsible for initiating the stage of shock must not be neglected Sometimes it is necessary to treat the shock first, i e. the patient s general condition must be restored before the primary injury can be dealt with but in many cases the nature of the primary injury is such as to cause the shock to persist, and in such circumstances obviously it is necessary to treat the injury as soon as possible

The use of heat in shocked patients has been the subject of much controversy Formerly warm blankets, hot bottles and electric heaters were regarded as invaluable, and indeed the application of heat was a cardinal principle of treatment. It has been assailed on two grounds (1) Since the skin vasoconstriction is regarded as a compensatory mechanism it should not be interfered with. (2) Since refrigeration is now known to be an effective method of preventing shock in certain

prolonged operative procedures it seems illogical to treat shock by the *reverse process* *Convincing though these arguments appear* they are not free from fallacy and the whole subject is much more complicated than this simple exposition would suggest. Practical experience indicates that the application of warmth is of real benefit, provided that it is carried out in moderation

In cases of severe persistent shock where these measures are in effective, intravenous nor adrenalin may be of value. Four mg of nor adrenalin (4 ml of 1/1000 solution) is added to 10 oz. of saline, and the rate of flow adjusted according to need It causes peripheral vasoconstriction and thus tends to restore the blood pressure, and is valuable as a *temporary expedient, but if the cause of the shock is not treated* its value is not sustained Moreover the intense local vasoconstriction may cause sloughing or even widespread gangrene, at the site of injection

HÆMORRHAGE

Hæmorrhage may be primary when it occurs at the time of injury; reactionary when it occurs after the blood pressure, diminished by the shock of injury again rises secondary when it occurs (seven to ten days later in most cases) as a result of wound sepsis Hæmorrhage *may be external at the skin surface internal, into a viscus or body* cavity or interstitial (extravasation) The bleeding may be from an artery when the blood is bright red (unless the patient is cyanotic) and issues in jets from a vein, when it is dark red or purplish and flows continuously from capillaries, when it appears as a steady ooze, rarely copious.

Natural Arrest of Hæmorrhage. This depends partly upon retraction and contraction of *the wall of the injured vessel, partly upon coagulation* of the blood

When a vessel is completely divided its circular muscle contracts, whilst the intima retracts so as to occlude the orifice. For this reason there may be comparatively little bleeding after complete division of even a considerable artery while if the injury has been such as to twist the vessel before dividing it—for example, when a limb is wrenched off —even a large vessel such as the axillary artery may give rise *to little* hæmorrhage

When a vessel is incompletely divided contraction of the circular muscle fibres and retraction of the intima have the effect of enlarging the orifice, and thus the bleeding may be copious even from a small wound. When such a lateral wound heals the scar may stretch and later give rise to a traumatic aneurysm (p 82)

Effects of Loss of Blood. A healthy adult male can tolerate the loss of 25 to 30 oz. of blood with little more than transient weakness. On the other hand, children and aged persons and debilitated or sick persons *may suffer* considerably from the loss of quite a small amount of blood

The sudden reduction of blood volume is counteracted rapidly by reflex arterial and venous vasoconstriction and is later made good by

fluid drawn into the vessels from the tissues As a result the blood becomes diluted This dilution, as judged by hæmoglobin estimations is sometimes used as a guide to the amount of blood lost but it is not an accurate index (unless the hæmorrhage has been arrested for several hours) as the dilution proceeds slowly

The loss of hæmoglobin impairs oxygen transport and causes anoxæmia, which in turn leads to tissue malnutrition and the accumulation of toxic products of cellular activity Thus the muscles including the myocardium are weakened and heart failure may result.

Treatment of Hæmorrhage. Apart from the measures required to arrest the bleeding the immediate treatment is to put the patient to bed with the head lowered and to give a full dose of morphia. If the hæmorrhage has been severe transfusion of citrated whole blood should be carried out.

Later convalescence should be accelerated by giving iron by mouth or by repeated blood transfusions.

Arrest of Hæmorrhage in Emergencies

Hæmorrhage from Scalp Wound. The bleeding is free, for the numerous vessels are fixed firmly in the dense subcutaneous tissue, which prevents retraction of the cut ends The hæmorrhage is readily controlled by applying pressure upon the wound edges against the skull. After cleansing the wound and shaving the adjacent scalp, insert deep silkworm gut stitches to include the whole thickness of the scalp Bleeding ceases when the sutures are drawn tight. Do not attempt to tie off individual vessels, as they are firmly embedded and cannot readily be ligated If the bleeding is from the superficial temporal artery compress the main stem of this vessel against the zygoma.

Hæmorrhage from the Nose. Prolonged compression of the anterior nares is often effective. If it fails, remove clots and douche the nostril with hot water or boric solution If the bleeding point is visible—it is often situated in the septum within ½ inch of its lower anterior extremity—touch it with the point of a cautery or with a bead of chromic acid or a pledget soaked in adrenalin solution. If the bleeding continues, pack the anterior nares with a strip of gauze wrung out of peroxide solution If this fails, pack the posterior nares. To do this pass a fine catheter through the nostril, catch the tip as it overhangs the soft palate, and withdraw it through the mouth. Take a gauze pack about an inch in width and tie it with a silk thread leaving the ends of the thread long Attach one end to the catheter and pull the plug into position, guiding it with a finger in the mouth. The one end of the silk is fixed to the forehead with adhesive tape, whilst the other end is left long through the mouth, to be used for removing the pack.

Hæmorrhage after Extraction of Teeth. This annoying complication often calls for treatment some hours after the tooth has been extracted. The bleeding may prove severe and even dangerous Wash the mouth out thoroughly and inspect under a good light to identify the exact

point of hæmorrhage If the bleeding is from the socket, remove all clot and plug with a pledget of wool soaked in adrenalin solution and instruct the patient to keep the plug in position by biting on a wad of gauze. If, as is uncommon, the bleeding is in the gum, the vessel may be caught with a hæmostat and ligated, or failing this, it may be under run with a suture on a fine curved needle

Hæmorrhage after Tonsillectomy In mild cases, swab away all clot from the tonsil bed and apply pressure upon the bleeding point by a gauze pad held in the point of a hæmostat, making counter pressure from the outside of the neck. Give an opiate hypodermically In severe cases give an anæsthetic, gag the mouth open remove blood clots and ligate the bleeding point. Failing this, suture the anterior and posterior pillars of the fauces together In secondary hæmorrhage from an infected tonsillar bed it may be necessary to ligate the external carotid artery

Hæmorrhage from the Tongue. This is most likely to arise from an ulcerating growth or after operative resection of part of the tongue. The hæmorrhage may be controlled by hooking the tongue forcibly forwards so as to compress the lingual arteries against the mandible. If this fails, it may be necessary to ligate the lingual artery or the external carotid artery

Hæmorrhage from Wounds of the Upper Limb A wound in the palm, which may bleed severely should be packed, and the hand bandaged tightly gripping a ball of wool. If this fails, and in wounds of the forearm and arm, apply a tourniquet must below the shoulder Wounds too high to be thus treated should be controlled by packing or if this fails by compression of the subclavian artery against the first rib The patient's head is bent forwards and to the affected side, and pressure is exerted backwards and medially in the lower anterior angle of the posterior triangle.

Hæmorrhage from Wounds of the Lower Limb If direct pressure and packing fail, apply a tourniquet to the thigh. If the wound is too high for this, apply manual pressure upon the femoral artery (midway between the anterior superior spine and the symphysis pubis) at a point immediately above the inguinal ligament, where the artery lies on the pubis.

Hæmorrhage from a Varicose Vein. This may be profuse and even dangerous. It is easily controlled by elevating the limb and applying direct pressure at the site of hæmorrhage.

Gastro-intestinal hæmorrhage is described on p 394

Secondary Hæmorrhage

Secondary hæmorrhage occurs in infected wounds if the wall of a large artery undergoes inflammatory softening or if a ligature loosens and the occluding thrombus disintegrates. It is most likely to occur when there is much sloughing or when a fragment of bone or a foreign body presses upon the artery In most cases an ooze of blood or a

sudden slight hæmorrhage gives warning, and later there is a severe leakage which may prove rapidly fatal

If there appears to be danger of hæmorrhage from a wound of an extremity a tourniquet should be applied loosely to the limb above the wound, and the nurse in attendance instructed to tighten it at the first sign of bleeding If the wound is not thus controllable, it may be advisable to perform a prophylactic ligation of a main artery through a separate incision proximal to the wound In an emergency the wound should be packed.

BLOOD TRANSFUSION

Transfusion of whole blood is indicated for hæmorrhage (and the allied state of oligæmic shock) for certain forms of anæmia and in certain blood dyscrasias. Stored blood is entirely suitable in most cases, but freshly drawn blood is essential for hæmophilia. Transfusion of concentrated red cells is indicated for anæmias in which it is desired to raise the hæmoglobin level but not the blood volume.

Pooled plasma or serum (dried or fluid) is preferable for burns and can be used for acute hæmorrhage where compatible blood is not available. Plasma or serum can be given without regard to blood grouping There is a risk of transmitting the virus of hepatitis, but to minimise this risk it is usual to pool the plasma of only two or three donors.

Plasma substitutes are solutions of synthetic substances with large molecules, having viscosity and colloid osmotic pressure similar to that of plasma. Their main use is to restore a depleted blood volume when supplies of blood or plasma are not available. By diluting the blood they lower the hæmoglobin concentration, the protein level and the level of clotting factors. They should therefore be used with discretion and in limited amounts. Since they interfere with compatibility reactions, blood should be drawn off for testing first.

Compatibility Tests. In addition to the group tests and Rhesus factor tests which are usually performed at the transfusion centre, a

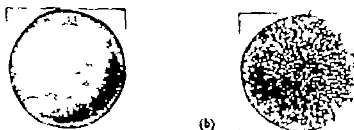


FIG. 14 Blood compatibility test. (*a*) Compatible. (*b*) Agglutinated.

direct test must always be made on every bottle of blood used About 3–5 ml. of the recipient's blood is withdrawn by venepuncture into a clean dry syringe free from antiseptics. In infants, 10–20 drops can be obtained by heel stab The blood is spun after clotting to give a clear serum. Two drops are placed on a slide or watch glass. A very small drop of donor's blood, diluted with 2 drops of citrate or saline solution is

added Agglutination will generally be obvious to the naked eye in ten minutes (often much sooner) but to avoid minor degrees of incompatibility a full twenty minutes should be allowed

Rhesus Factor Irrespective of their groups the corpuscles of 85 per cent. of persons contain a Rhesus agglutinogen (Rh factor) so called because a similar one is found in the Rhesus monkey These Rh positive people are habituated to their own Rh factor A Rh negative person, on the other hand may become sensitised as a result of frequently repeated transfusion of Rh positive blood and will then suffer a reaction when given a further transfusion of Rh positive blood. A Rh-negative woman during pregnancy may become sensitised by a Rh positive fœtus and will then sustain a reaction if transfused with Rh positive blood It should be noted that the ordinary direct matching test gives no warning of this risk the test for Rhesus incompatibility is much more delicate and requires special technique and experience.

Withdrawing Blood from the Donor The donor should be in good general health sufficiently robust, and free from malaria, syphilis or other communicable disease

The anticoagulant in routine use is sodium citrate. Generally a 3 8 per cent. solution is used 1 part to every 0 parts of blood giving a final concentration of 0 38 per cent. Less concentrated solutions, with or without other constituent salts, have also been recommended.

In withdrawing the blood full antiseptic precautions must be used and exposure to the air must be reduced to the minimum. The routine withdrawal apparatus consists of a needle and tubing which can be connected with a vacuum bottle containing the anticoagulant.

The donor lies recumbent, with his arms supported either close to the body or abducted, as may be most convenient. A sphygmomanometer cuff applied to the arm is inflated to 90 mm Hg

When the antecubital area has been sterilised and towels applied a drop of local anæsthetic is injected so as to raise a wheal close to a suitable vein. A wide-bore needle with a short bevel, preferably a special thin walled transfusion needle, is then inserted into the vein in a proximal direction. When the blood flows the tube is connected to the flask when the vacuum causes a rapid flow Rapid mixing is effected by rotating the bottle while the blood is being collected

Storage of Blood. Stored blood is as effective as fresh blood in almost all types of case, and has the great advantage of being readily available *in emergencies*

Whole blood can be stored at 4°C –6 C. for ten days. Before use it must be inspected with care. There should be a clear line of demarcation between the sedimented cells and the supernatant plasma which should be straw coloured and free from hæmolysis. Any bottle not conforming to these standards must be rejected

Concentrated red cells should be used within twelve hours of preparation *Pooled plasma should be stored in a dry dark place and must not be used unless crystal clear for cloudiness or deposits may be due to bacterial contamination.*

Administering the Blood. The administration outfit consists essentially of a rubber bung fitted with an air inlet tube and an exit tube connected by rubber tubing to an intravenous needle or glass cannula. Various types of filter are introduced into the exit tube to hold up any clot that may have formed. A drip bulb and screw clip are added if slow transfusion is desired.

The blood on removal from the refrigerator may be kept at room temperature for half an hour. It can safely be transfused cold and should not be heated owing to the risk of hæmolysis. However, in infants where much blood is to be given it may be warmed gently in water at 40°C.

The bottle of blood complete with administration outfit, is inverted and blood allowed to fill the tubing which is then gripped by a screw clip or hæmostat. All is now ready to administer the blood. Venepuncture is carried out as described on p. 0. The needle or cannula is then connected into the tubing and the blood allowed to flow.

The rate of flow should be adjusted according to the needs of the patient. After severe external hæmorrhage the blood should be transfused rapidly; as much as 100 ml. per minute may be given. In an anæmic patient with a damaged myocardium, or in any toxic condition the rate should not exceed 40 drops per minute.

The total volume given must be adjusted to the needs of the patient. In a healthy subject following acute blood loss two or three pints may be given rapidly until the systolic pressure reaches 100 mm. Hg and thereafter the rate slowed. In treating anæmia it may be assumed that one pint bottle of whole blood will raise the hæmoglobin level by 7 per cent. and one pint of concentrated cells by 14 per cent.

When the transfusion has been completed the tubing and drip-set should be washed at once by flushing with cold tap water. The bottle with the residue of blood must be kept unwashed for two days to have it available for investigation in case of a late reaction.

Reactions after Blood Transfusion. The *febrile reaction* with a mild pyrexia lasting a few hours, attributed to pyrogens derived from dead bacteria present in the fluid or in tap water used for cleansing the apparatus.

Major reactions may be due to Rhesus agglutination (p. 42) or to mis-matched blood. Generally the first evidence of a reaction occurs shortly after the transfusion has been begun. There is a feeling of malaise with throbbing in the head, a sense of tightness in the chest, pain in the back and limbs. If the transfusion is continued, respiration becomes laboured, cyanosis develops, the pulse becomes rapid and weak, and death supervenes. If on the other hand the transfusion is stopped when the first symptoms become apparent the patient may recover and will later present hæmoglobinuria and jaundice, resulting from destruction of the transfused red cells.

Anuria is a rare complication. It is generally attributed to obstruction of the renal tubules by acid hæmatin but it is probable that acute tubular necrosis occurs in some cases. Preliminary administration

of alkalies reduces the risk of this complication and should always be adopted when time permits. The treatment is as for other types of anuria (p 478)

Reactions due to infected blood have been described. They are fulminating and rapidly fatal. To prevent their occurrence the blood must be inspected carefully (see above) before use.

Transfusion of Blood Plasma. Plasma is indicated in preference to whole blood in traumatic shock, where the aim is to restore the volume of fluid in circulation and where the administration of red blood cells is not merely unnecessary but even in view of the hæmoconcentration present, undesirable.

Plasma is obtained from citrated blood and can be stored in the fluid state at room temperature for several months, or can be dried and stored in the form of a powder which can be dissolved in water as required.

Unless a very large volume is to be administered the blood group of the donor is unimportant and compatibility tests are unnecessary for the plasma is so diluted by the recipient s blood as to reduce its agglutination value to a safe level. The method of administration of plasma is the same as for whole blood

CHAPTER 8

BURNS AND SCALDS

Burns may be caused by heat, electricity radium or X rays Scalds differ in no essential from superficial burns.

A severe burn presents two distinct problems, the initial constitutional upset and the local damage to the integuments.

The *constitutional upset*, formerly known as shock or toxæmia, is now recognised to be due simply to disturbance of the fluid balance. In a severe burn there is a copious loss of fluid at the burnt surface, into the blisters and in the œdematous tissues deep to the burn The fluid is very rich in proteins. As a result, the circulating blood is greatly diminished both in volume and in protein content while there is a relative increase in the corpuscular content. This is demonstrated by a rise in the red cell count, perhaps to 6 million per c.mm., and a corresponding increase in the hæmoglobin level and the packed cell volume.

The loss of fluid and protein and secondary electrolyte changes lead to a condition comparable to shock, which may prove fatal unless promptly treated. It is important to note that the shock takes a few hours to develop and the patient's condition before this gives no indication of the imminence or extent of the danger The degree of shock is roughly proportional to the extent of the burn and this may be used both as an index of prognosis and a guide to treatment. In an adult a burn involving 15 per cent. of the body surface (roughly equivalent to the surface of the lower limb up to mid thigh level) may be expected to give rise to a good deal of shock. In children a burn of half this extent should be regarded as serious.

The *local lesion* depends on the depth of the burn. Three degrees are recognised (1) mild erythema, (2) superficial destruction of the epidermis with blistering, (3) deep destruction involving the whole epidermis. In burns of the first and second degree, since the basal layer of the epidermis is intact, healing occurs rapidly with little or no permanent blemish. In deep burns the integument forms a slough which in due course is cast off, leaving an ulcer which unless skin-grafted heals slowly and with much fibrosis and scarring Such scarring over a flexure or in the hand and fingers will lead to gross deformity and crippling In practice, most severe burns are partly superficial and partly deep

Complications of Burns. In burns of the face from fire or explosions irritation of the larynx may lead to œdema of the glottis, necessitating urgent tracheotomy Bronchitis or bronchopneumonia may also occur Toxic jaundice is an occasional and grave complication An acute bleeding or perforating ulcer (Curling's ulcer) is an occasional complication, especially in children.

First Aid. In minor burns, cleanse thoroughly with soap and water and puncture any blisters. Apply, if available, either penicillin sulphonamide powder or simple sulphonamide powder or sulphonamide cream (see below) and cover with a copious sterile dressing Leave it undisturbed for ten to fourteen days.

In all but the most trivial burns, apply warm blankets and hot bottles and administer morphia, cover the burn with a sterile dressing and send the patient into hospital Do not apply any oily or greasy dressing as this will interfere with subsequent treatment.

Hospital Treatment *The Constitutional Upset* In a severe burn active measures should be taken immediately on admission to hospital to avert shock, even though, as often happens, the patient's condition at this stage gives no indication of impending danger The essential treatment is to replace the lost fluid and protein but other measures should be taken as for shock. A full dose of morphine (gr ¼ for an adult) is given The patient should be kept warm but do not overheat as the mechanism for heat loss by sweating is impaired

Blood plasma should be given at once, and in severe cases two pints may be given rapidly under pressure Thereafter a plasma drip is maintained, the rate being determined by the blood concentration as estimated by repeated hæmoglobin or red cell counts As much as 8 to 10 pints may be required in the first twenty four hours

The local treatment. (*a*) The primary object is to control infection by initial cleansing This is done under morphine narcosis except in young children, who require light gas and oxygen anæsthesia. The skin is gently mopped with swabs soaked in an antiseptic such as Cetavlon or 1/1 000 biniodide of mercury The cleansing will take at least five to ten minutes. Blisters are opened and all loose epidermis removed (*b*) In the past, innumerable methods of dressing the burn have been devised including ointments, coagulants such as tannic acid, various antiseptics and antibiotics. For routine use the best method is to apply a thick layer of penicillin cream, covered with gauze or tulle gras and with several layers of cotton wool, the whole held in place and gently compressed by crepe bandages. A light plaster may be applied to a limb to secure immobilisation. The dressing is left in place for ten days

In burns of the face and selected cases of burns of the chest, back or buttocks, the exposure method is probably the best. After initial cleansing the burn is dried and given a copious dusting with penicillin sulphonamide powder and is then left fully exposed No dressing is applied but a wire cage is used to keep the blankets off if the burn is on the back or buttocks, the patient is nursed in the prone position. Under such conditions the dry scab which forms on the surface gives good protection against secondary infection If necessary this protection can be enhanced by oral antibiotics.

(*c*) Whatever method is followed, if the burn is deep much of the skin will slough. At the end of a week or ten days all dead tissue should be excised. After antibiotics for a further period of a week or so the area should be ready for the application of skin grafts. As a rule, split skin

grafts are used (p 57) In very extensive burns homografts from a volunteer donor may be used as temporary cover

(*d*) In the late stages of severe burns commonly a state of inanition develops, with marked anæmia and progressive weakness. It is thought to be due partly to continued loss of protein and partly to interference with sulphur metabolism consequent on the skin destruction A high protein diet should be given with an abundance of sulphur-containing foods. Repeated blood transfusions and infusions of casein hydrolysate may be necessary

Burns of the Face and Eye. A burn of the face is best treated by application of penicillin sulphonamide cream. Healing takes place rapidly but if the burn is near the lower eyelid there is a risk of ectropion which may lead to corneal ulceration If the eye is involved the conjunctival sac should be thoroughly cleansed by saline irrigations, followed by a simple ointment. The irrigation is repeated thrice daily If the cornea is involved an atropine ointment is used. The eye should be protected by a shield If there is much pain, decicaine or percain may be instilled

Burns of the Hands and Fingers. These burns commonly lead to much stiffness and disability In some cases thrombosis of the digital vessels leads to gangrene of the fingers. Various methods of treatment are advised. The method most favoured at the present time is to apply penicillin sulphonamide cream and immobilise the limb on a splint or in a light plaster case, elevating it to prevent œdema, on the supposition that the sooner healing is achieved the less scarring and stiffness will ensue.

Electric Burns Electric burns may follow lightning stroke or result from contact with live wires carrying high voltage current. The burns are often severe, and accompanied by marked shock.

In lightning stroke the injuries may be very extensive. In other cases the burns are most severe at the points of contact with the live wire and the earth. They cause deep sloughing and are very slow to heal. They should be treated by applying eusol dressings until the sloughs have separated and later by skin-grafting

X ray and Radium Burns. These burns result from simple over exposure to the rays. At the time nothing unusual is noticed and the burn only becomes manifest a week or more later It gives rise to deep necrosis of tissue, often very painful and very slow to separate and heal. The treatment is as for electric burns. In a favourable situation it is sometimes advisable to excise the whole burnt area.

CHAPTER 9

THE SKIN AND SUBCUTANEOUS TISSUES

ULCERATION

ULCERATION of the skin may arise from any of the following causes, alone or in combination —

(1) Trauma, e.g pressure sores, burns.

(2) Deficient circulation, e.g Varicose ulcer

(3) Impaired trophic innervation, e.g Trophic ulcer

(4) Bacterial infection.

(5) Malignant disease.

Many of these ulcers are described in the appropriate chapters. Here it is necessary to deal only with pressure sores and the closely related trophic ulcers

Pressure Sores and Trophic Ulcers

Pressure sores may occur in healthy subjects as a result of prolonged pressure by a tight splint or plaster of Paris cast. Much more often, however, they occur in cases of impaired trophic innervation, due to



FIG. 15 Large bed sore over the sacrum, in an incontinent paralysed patient.

disease of the spinal cord or peripheral nerves. Pressure sores are thus common in those suffering from tabes dorsalis and spinal injuries.

Bed sores are pressure sores occurring in debilitated persons confined to bed. They are especially common in paralytics and in those inconti nent of urine or fæces. The sores are situated over the sacrum, or sometimes over the buttocks, heels or other pressure points, and are due to the combined effects of pressure, moisture and infection. At an early stage they cause merely a discoloration of the skin or a small area of

ulceration In severe cases they may lead to extensive sloughing of the soft tissues, even down to the bone They give rise to marked toxæmia from septic absorption

Treatment. The best treatment is preventive. The skin over the sacrum and the pressure points must be kept scrupulously clean, and a barrier cream rubbed in The draw sheet must be kept clean and free from creases. Finally and most important of all, the patient must be moved frequently e.g at hourly intervals from one side to the other and if possible got up daily into a chair

If a pressure sore develops it should at first be kept dry and aseptic by spirit applications and sterile dressings A small sore may be covered with elastic adhesive plaster and left undisturbed for several days. If it becomes infected eusol dressings may be used to hasten separation of the sloughs. Later the raw area may be covered by skin grafts, or by turning in a flap of skin from the buttock

Trophic ulcers occur mainly as a complication of defective innervation (owing to the loss of the protective effect of pain sensation) in such lesions of the cord as occur in fractured spine, spinal tumour and spina bifida. The ulcers may occur on the buttocks over the sacrum or other bony prominences, or on the lower limbs.

If acute and highly infected, the ulcers spread extensively with much sloughing of the soft tissues and severe general toxæmia. This is the cause of death in many cases of fractured spine with paralysis.

If chronic, on the other hand the ulcers cause little reaction. The perforating ulcer in tabes, or rarely in spina bifida, is of this type. It is generally situated on the heel or on the ball of the great toe, and extends deeply to the bone. It becomes lined by epidermis and surrounded by thick horny callosities. It is generally quite painless.

The treatment for acute trophic ulcers is the same as for bed sores In chronic cases the horny callosities should be sliced off with a razor and the ulcer scraped with a sharp spoon. Lumbar ganglionectomy is sometimes of value, by increasing the vascularity of the part.

BOILS AND CARBUNCLES

A boil or furuncle results from invasion of a hair follicle or sebaceous gland by the *Staphylococcus aureus* A localised abscess forms, in the centre of which is a slough resulting from necrosis of the follicle or gland

Boils usually occur in healthy young adults, but tend to be most severe in debilitated or diabetic subjects. They occur most often in the skin at the back of the neck, on the forearm, or in the peri anal region. In dense tissues, such as the nostrils or external ear or in sensitive regions, such as the perineum, boils are intensely painful. The constitutional effects may be mild or severe.

Recurrent boils are common, especially in debilitated persons. They result from infection of neighbouring skin glands or follicles by pus from the original focus.

A *carbuncle* is similar to a boil but larger more extensive and more



FIG 16 Carbuncle of the lumbar region, in a diabetic patient. Note the wide area of brawny induration and the multiple points of suppuration.

severe in its effects. It is apt to occur in old debilitated people and in diabetics.

Treatment. A small boil should be protected by a circle of adhesive elastic strapping 2 inches or so in diameter the centre of the boil being separated from the strapping by a small disc of gauze or by dressings soaked in a saturated solution of magnesium sulphate in glycerine.

The surrounding skin should be bathed frequently with spirit to prevent re-infection and the collar or underwear must be changed frequently

If these simple measures fail and especially in recurrent boils, penicillin should be given. It is rapidly effective. Any underlying disease such as diabetes should be treated too

TUMOURS AND CYSTS OF THE INTEGUMENTS

Implantation Cyst. This condition is generally attributed to accidental displacement of epidermis under the skin. It occurs most often on the palmar aspect of a finger usually as a sequel to injury by a thorn, needle or pointed tool. The cyst forms a rounded swelling the size of a large pea, attached to the deep surface of the skin It may be removed under local anæsthesia.

Sebaceous Cyst or Wen. These cysts occur mainly on the scalp face or back, and are commonly multiple smooth and rounded A sebaceous cyst is attached to the skin by its duct and causes slight dimpling of the skin when displaced to one side. This feature serves to distinguish it from a lipoma, fibroma, dermoid cyst or chronic abscess.

The cyst may grow slowly and eventually attain the size of a walnut. It may become infected and form an abscess or an ulcer The contents of the cyst may ooze out and harden to form a sebaceous horn

The treatment is to excise the cyst this can be done conveniently under local anæsthesia. The cyst may be dissected out, but if it is



FIG 17 Implantation cyst in web between index and middle fingers, arising as a sequel to a splinter prick.

adherent a simpler method is to bisect it by a single cut, squeeze out the cheesy content and then avulse the two halves of the fibrotic wall

Sebaceous Adenoma. This rare tumour grows most often on the face or scalp It forms a rounded swelling projecting under the skin to which it is adherent. It may ulcerate and bleed Rarely it becomes carcinomatous A similar tumour arises from sweat glands it too may become carcinomatous

Papilloma. Various types of skin papilloma occur Thus certain congenital moles, raised warty and sometimes hairy growths, have this character and consist of overgrowths of epidermal cells, often heavily pigmented. The common corn is another form of skin papilloma. Thirdly there is the contagious wart, which often occurs on the fingers and hands. Lastly there are venereal warts, similar in appearance, or more florid and soft, which arise by contagion in sexual intercourse, and are usually situated in the genital region

Treatment. Moles are generally best left untreated, unless they become ulcerated or show any tendency to increase in size, when they should be promptly removed by operation or if too large, exposed to radium. It is important that if operation is advised it should be thorough, for incomplete removal may precipitate malignancy

Contagious warts may be painted twice daily with 5 per cent. solution of salicylic acid in collodion, or may be destroyed by an application of carbon dioxide snow If preferred, the actual cautery may be used the point being allowed to sink vertically into the wart until pain is felt. If these measures fail, exposure to X rays gives good results.

Rodent Ulcer (Basal-cell Carcinoma) This ulcerating tumour originates from the basal cells of the epidermis. It occurs most commonly in the upper part of the face, especially near one of the orbital commissures. It starts as a small papule or button like induration under the epidermis. At an early stage it ulcerates and the ulcer enlarges, painlessly and very slowly invading and destroying



Fig. 18 Rodent ulcer of face.

the adjoining tissues until eventually it covers a large area and may extend into the bone. In its progress it may lead to the destruction of the nose or the orbital tissues It does not metastasise.

The ulcer has a granular encrusted surface and a rolled, beaded edge which is distinctly indurated It may heal temporarily at one edge while progressing at the other

A rodent ulcer is to be diagnosed from a squamous epithelioma, in which the edge is more raised and indurated, and the base of the ulcer



Fig. 19 Squamous epithelioma of face.

is also raised above the general skin level Biopsy should be performed as a routine.

Treatment A small rodent ulcer may be removed by operation A large one, or one so placed that removal would lead to deformation, should be exposed to radium or to X rays. An exception is an ulcer of the upper eyelid which should always be excised, as irradiation is apt to lead to cataract The irradiation should be thorough to avoid recurrence

Squamous Epithelioma. This malignant tumour of the epidermis is characterised microscopically by the presence of keratinised cell nests and prickle cells. These features, among others, distinguish it from a rodent ulcer

The tumour occurs in any part of the skin, most commonly on the face and lips. It frequently arises as an end result of chronic irritation. Epithelioma of the lip for example, occurs in pipe-smokers, while shale-miners cancer, tar cancer and mule spinners cancer arise as a result of irritation by paraffin products. Epithelioma may also arise at the edge of a simple ulcer or cicatrix, a burn or a patch of lupus.

The growth may take a warty form, but more often it ulcerates The ulcer is raised above the general skin surface and often is small in extent, but with a raised indurated margin and an underlying button zone of induration extending beyond the limits of the ulcer The growth invades the adjacent tissues and gives rise to metastases in the regional glands.

Diagnosis Epithelioma must be diagnosed from simple papilloma, simple ulcers and fissures rodent ulcer and gumma. Biopsy should be performed as a routine.

Treatment. When feasible, the tumour should be excised, along with a wide margin of healthy tissue. The regional glands should be removed at the same time or subsequently When excision is not practicable, radium should be applied either as a surface plaque or by needles inserted around the tumour, or X ray therapy may be preferred In certain sites, e.g the lip, the results of irradiation are so satisfactory that this form of treatment is often preferred to excision.

Molluscum Sebaceum. This remarkable tumour on microscopic examination is almost indistinguishable from squamous epithelioma, but in its behaviour is entirely different. It starts as a pimple, often on the face, enlarges very rapidly for four or five weeks, then in two or three months heals spontaneously leaving a small depressed scar It forms a raised shell like almost spherical mass, as much as 3 cm in diameter surmounted by a covering of keratinised material. It is distinguished from carcinoma by its rapid growth and lack of deep fixation. No treatment is required, but radiotherapy may be used to expedite healing

Melanoma. A melanoma or pigmented tumour of the skin may be present at birth or develop at any age. Congenital melanomata include pigmented spots or patches, and also warty pedunculated or hairy moles. They are sometimes called nævi, but the term nævus (Latin, a birthmark) also includes angiomata.



Fig 20 Melanocarcinoma in a man aged 22, who first noticed a small ulcer at the heel a year previously There were secondary nodules in the subcutaneous tissue along the lymphatics of the leg and the glands in the groin were enlarged. Treated by block dissection of the primary growth lymphatics and glands.

Most congenital melanomata remain simple throughout life, but a few of them, and many acquired melanomata, assume malignant characters, perhaps after many years. Generally malignant change is indicated if the growth becomes more vascular or ulcerates or enlarges.

Acquired melanomata are nearly always malignant. They generally form brown or black warty growths, raised above the skin surface. They are common in the face and also occur in the pigmented coats of the eye They also occur commonly in the skin of the heel or in relation to a toenail

Whether the malignant change develops as a secondary change in a

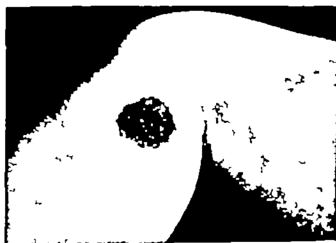


Fig 21 Simple melanoma of congenital origin, in a woman aged 30 The growth, which was situated on the outer side below the knee had recently caused irritation and some bleeding It was therefore excised.

benign congenital melanoma, or *de novo* in an acquired melanoma, it constitutes a highly dangerous disease. Sometimes the malignant cells spread primarily by lymphatics to the regional glands, sometimes they invade the blood stream and disseminate to distant sites. In either case the progress is often a rapid one and the disease may spread far and wide while the primary growth remains small and apparently innocent. But melanoma is a fickle disease and sometimes in an apparently hopeless disease the radical removal of all diseased tissue leads to a cure or at least to a long reprieve.

Treatment. A simple melanoma generally requires no treatment, but, if desired, it may be excised. Care must be taken to excise widely, for incomplete removal is very apt to precipitate malignancy. General anæsthesia should be used, and often a plastic repair is necessary to



FIG. 22. Malignant melanoma (melano-carcinoma) in a man aged 70. The tumour had originated in a small congenital mole and had recently enlarged rapidly and ulcerated. There were no palpable glands. Treatment by excision of growth and regional glands.

cover the wide raw area which results. A malignant melanoma, or one suspected of becoming malignant, should be excised along with a wide margin of healthy tissue. If feasible, the regional lymph glands should also be removed by a block dissection, including also the lymphatics and surrounding subcutaneous tissues between the growth and the glands. The precise method must depend on the site. In a sub-ungual melanoma, a comparatively benign variety, it suffices to amputate the digit. In a melanoma of the foot or heel (usually much more malignant) opinion differs as to whether a below knee amputation should be performed or a very wide excision of the integuments with immediate skin grafting. In either case the glands of the groin must be excised and some surgeons also remove the whole intermediate lymphatic tract. In exceptional cases disarticulation at the hip or a forequarter amputation is necessary. Radium is of little value in the treatment of melanoma.

Lipoma. A lipoma is a lobulated tumour consisting microscopically of fat cells enclosed in a fibrous stroma. It is an encapsulated growth which enlarges slowly, and may eventually attain a large size. It occurs commonly in the subcutaneous tissue, especially in the shoulder region or the back. Less often it occurs in the intermuscular septa, in the extraperitoneal tissues or deep to the periosteum.

The common subcutaneous lipoma forms a soft, semi fluid swelling smooth and rounded and generally lobulated, and nearly always it may be distinguished by the fact that the overlying skin is tacked down to it and may be dimpled by displacing the tumour The treatment is to remove the growth if it is unsightly or so large as to cause inconvenience.

Diffuse Lipomatosis is a condition characterised by overgrowth of the subcutaneous fat. It is usually most marked in the neck, over the shoulder regions, and in the lower abdomen. In some cases severe pain is caused—adiposis dolorosa. The treatment is by X ray therapy

Liposarcoma is a rare condition of low-grade malignancy characterised by slowly spreading fatty growths in the subcutaneous tissue or behind the peritoneum. The condition may give rise to severe pain sometimes of neuralgic type. The treatment is by X ray therapy

Other Tumours of the Skin include angioma (p 80) neurofibroma (p 72) and sarcoma.

AFFECTIONS OF SCARS

Keloid (Greek χηλη a claw) is an overgrowth of fibrous tissue which results in the formation of a fine irregular claw like mass of tissue in a scar It may affect any form of scar but is most common in tuberculous scars, especially in mobile areas such as the neck. It is then very disfiguring Keloid is common in the dark races, and is seen regularly in the ritual scars of African tribes. The treatment is by exposure to X rays.

Contraction of Scars occurs especially as a sequel to prolonged wound infection. It is common after burns. The contracture may cause much disfigurement or crippling If treatment by massage and gradual stretching fails, the scar should be excised and the raw area covered by skin grafts.

Stretching of Scars occurs most often in the neck, especially if the wound has been septic or if the platysma has retracted. The treatment is to excise the scar

Pain in Scars is generally caused by implication of terminal nerve filaments in the fibrous tissue. It is seen most often in amputation scars. The pain is of a shooting character and often there is a very localised area of tenderness over the affected nerve-end. The treatment is to excise the nerve-end along with the tender area of the scar

Epithelioma in Scars arises as a rare complication of incompletely


FIG. 23. Keloid in scar following burns.

healed lesions, e g burns, lupus, chronic ulcer It is a squamous epithelioma, which grows very slowly whilst it is limited to the tough scar tissue, and only metastasises when it reaches healthy tissue with permeable lymphatics

SKIN-GRAFTING

The following are the main methods of skin-grafting —

Split-skin Grafts. These are used mainly for wounds with extensive skin loss and for covering granulating areas. The graft is taken from the medial aspect of the arm or thigh or the abdominal wall. It includes the whole epidermis and part of the dermis, but the hair follicles and skin glands are left and provide islets of epithelium which rapidly enlarge and cover the donor site. Formerly thinner Thiersch grafts of epidermis only were used, but they tend to wrinkle and contract. These grafts may be cut with a razor or special knife held almost flat and moved with a rapid sawing movement, the skin being held smooth and firm by means of the straight edge of a wooden board Alternatively a dermatome may be used, an instrument consisting of a metal drum with a knife set against its outer surface. To use it the donor skin is painted with adhesive so that when the drum is rolled

over it the skin is lifted against the knife and a graft of measured size and thickness is cut.

Such a graft is trimmed to fit the raw surface, fixed at the margin by fine silk sutures covered with a pressure pad of wool soaked in proflavine-paraffin and held in uniform contact by a firm dressing which is left untouched for a week or more. Strict asepsis is essential, and in the case of granulating areas a preliminary course of treatment by penicillin cream or eusol dressings may be required

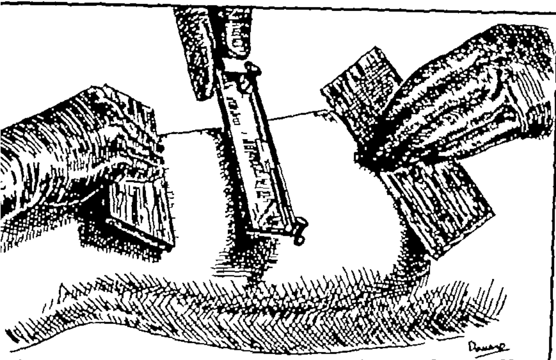


FIG 24 Split-skin graft being elevated from anterior aspect of thigh.

Whole-skin Grafts. These grafts which include the whole thickness of the skin, do not "take" so readily as split-skin grafts, but have the advantage that they are of better texture, yield a more satisfactory cosmetic result and do not contract. An area of the exact size and shape required is marked out on the donor site and dissected up the resulting defect being closed by sutures after undermining the skin edges. Suitable donor sites are the skin behind the auricle or the medial side of the arm

Skin Flaps. A skin flap differs from a skin-graft in that it retains a partial connection with its original site and derives a blood supply from it. Local skin flaps are used to cover wounds or other defects and for a variety of plastic procedures. The skin may be advanced by the V Y method in which a V incision is sutured in the form of a Y or a flap be rotated or transposed The general plan is to cover the defect at the expense of an adjacent area where *the skin is redundant* and can be drawn together more easily or from an area which can be covered effectively by a free skin-graft.

Pedicle Grafts Grafts of this type are useful to remedy defects of the hands or face. Where a skin defect of the fingers or hand is to be made good it is generally most convenient to raise a flap from the abdomen The free margin of the flap is sutured to the edge of the hand defect while its base remains anchored to the abdomen as a source of blood supply The raw area of the abdominal wall is closed by under mining the edges or by split skin grafts Three weeks later when the flap has gained a new blood supply from the hand its connections with the abdomen are divided

For facial defects the simplest type of pedicle graft is obtained from the thorax; parallel incisions are made in the skin of the thorax the intervening strip of skin is elevated and sutured as a tube both ends retaining their attachments. Two weeks or so later one end may be



FIG 23. Pedicle skin graft from abdominal wall, attached to wrist as stage in transfer to cover skin defect on foot.

divided, raised and stitched to one edge of the facial defect. When a new blood supply is gained from this source the other end is divided and the tube spread out to cover the facial defect.

Large facial defects such as result from war wounds require more complicated pedicle grafts, which may be taken from the forehead the thorax or even the abdomen Free grafts of cartilage may need to be embedded, e.g in the repair of nasal defects. Such plastic procedures require careful planning and skilled treatment to achieve satisfactory results

Homografts. Grafts from other human subjects (other than uniovular twins) always set up an antibody reaction which results in their being sloughed off in two or three weeks time. They have a certain value, however in the treatment of extensive burns to give temporary cover either for the whole area or parts of it, until such time as skin can be obtained from unburnt areas of the patient himself

CHAPTER 10

THE MUSCLES, TENDONS, TENDON-SHEATHS AND BURSÆ

Rupture of Muscles or Tendons

Examples of these lesions are seen in rupture of the biceps brachialis (p 150) of the plantaris tendon (p 207) The clinical features and treatment are considered on these pages

Hernia of Muscle

This rare condition most often affects the adductor longus or other muscles of the thigh. The muscle herniates through a gap in the deep fascia and forms a soft superficial swelling which may be mistaken for a lipoma, hernia, cold abscess or cyst, but may be diagnosed by the fact that the swelling disappears when the muscle actively contracts. The condition generally requires no treatment but if necessary the gap in the fascia may be closed by suture If it cannot be closed it should be enlarged for then the herniation is diffuse and painless

Dislocation of Tendons

Tendons lying in grooves may be dislocated if the retaining ligament or fascia is torn Not infrequently the injury results from a sudden violent muscular contraction taking place with the joint in such a position as to draw the tendon out of position. The long head of the biceps brachii may be displaced in this way Similarly the peroneus longus and brevis may be dislocated by a sudden muscular contraction with the foot everted, or the tibialis posterior by a like movement with the foot inverted.

The treatment is conservative in the first place. A pad of adhesive felt is placed over the site of injury and the joint is bandaged, or preferably fixed in a walking plaster for four or five weeks If the displacement recurs operation may be advised to repair the retaining ligament.

Avulsion of Tendons

This rare injury affects the tendons of a finger or toe which are torn out along with the terminal phalanx to which they are attached. The injury is generally due to the tip of the finger or toe being caught in rapidly moving machinery The treatment is to cleanse the wound and trim the stump

Myositis

Muscles may be involved in acute inflammatory processes, and are especially liable to infection by the organisms of gas gangrene (p 28) They may be involved also in any chronic inflammatory process in their vicinity whether suppurative, tuberculous, or even syphilitic. In addition muscles are subject to the following affections:—

Rheumatic Myositis (Muscular Rheumatism) This is more strictly an affection of the muscle sheaths and intervening connective tissues, and is more accurately termed *fibrositis* It is a common condition, well known under such names as "stiff neck," "pleurodynia and lumbago" It may follow a strain or arise spontaneously and is generally attributed to a chill or a draught. Novocain injected into the tender nodules brings about immediate,

though not always permanent relief Heat should be applied locally Radiant heat is of value and short wave diathermy is still more effective

Ischaemic Myositis (Volkmann's ischaemic contracture) This complication of injuries in the elbow region is described on p 147

Traumatic Ossifying Myositis Traumatic ossification in muscles or more accurately in muscle sheaths and intermuscular connective tissues is seen most often in the antecubital region (p 148) and in relation to the adductors of the thigh

In the latter region traumatic ossification is seen most often in those who have recently learnt to ride (riders bones) as a result of repeated strains of the adductor insertions

The treatment is to put the part completely at rest and to avoid massage and passive movements which tend to aggravate the condition If after several months the disability persists the bony deposit should be excised

Tenosynovitis (Tendo-vaginitis)

Acute Tenosynovitis. Two types of acute tenosynovitis occur —

Acute Traumatic Tenosynovitis may follow either a severe strain or a succession of minor ones It is seen most often in the tendon sheaths at the wrist as a sequel to over-exertion at tennis, fives golf or other sports. Occasionally it affects the sheaths at the ankle after much running or dancing The condition responds rapidly to complete rest for a few days, but is very apt to recur The treatment is to support the wrist by an elastic adhesive bandage or a leather wristlet.

Suppurative Tenosynovitis is seen most commonly in the tendon sheaths of the fingers and hand (p 108)

Chronic Tenosynovitis Chronic tenosynovitis may be tuberculous or non tuberculous:—

Tuberculous tenosynovitis may affect the common flexor sheath at the wrist, one of the digital sheaths of the fingers, or the peroneal



FIG. 26 Tuberculous tenosynovitis of the middle finger of six months duration, in a man aged 32 who also suffered from pulmonary tuberculosis. Note the atrophy of the rest of the hand.

sheath at the ankle. The disease is insidious in onset, and occurs mainly in adults. The wall of the sheath becomes infiltrated with tubercles and thickened, whilst turbid fluid collects within the sheath, containing flakes of caseous material and sometimes small "melon seed or "rice-grain" loose bodies The affected region presents a

painless, spindle-shaped swelling and the movements of the tendons and the related joint are impaired

The treatment is on conservative lines in the first place. If this fails operative excision of the sheath is indicated

Non tuberculous chronic synovitis is generally due to recurring strains The treatment at first is to support the tendon sheath, e.g by a leather wristlet.

Another form of chronic synovitis is the stenosing tenosynovitis which is encountered especially in the sheaths of the long abductor and short extensor tendons of the thumb It is described on p 101

Tumours of Tendon Sheaths

The chief varieties of tumours of tendon sheaths are the fibroma and the giant-cell tumour Both are far from common They are similar in naked eye appearance being small simple tumours of firm consistency and somewhat yellowish colour The treatment is to excise the tumour

Diseases of Bursæ

Traumatic Bursitis. A bursa, whether normal or adventitious, if subjected to repeated trauma undergoes chronic inflammatory change, becomes thickened and distends with watery fluid (bursal hydrops)

Examples of traumatic bursitis are bunion (p 217) chronic prepatellar bursitis (p 294) ischial bursitis or tailor s bottom olecranon bursitis or miner s elbow and enlargement of the bursa related to the tendo Achillis, resulting from shoe pressure

The treatment in an early case is to remove the cause of the traumatism The fluid may be aspirated If the wall of the bursa is much thickened it should be excised

Acute Infective Bursitis A bursa may be infected directly from an open wound or indirectly from cellulitis in the neighbouring tissues. Since bursæ are in free communication with the lymphatics of the part they are very apt to be involved in any spreading inflammation In this way the olecranon bursa and the prepatellar bursa are frequently involved in cellulitis of the extremities.

The treatment is to incise and institute drainage.

Individual Bursæ The special features of individual bursæ are considered in the regional chapters

CHAPTER II

THE PERIPHERAL AND AUTONOMIC NERVES

INJURIES TO NERVES

AN injured nerve may sustain a 'transient block' a 'lesion in continuity' or partial or complete division

A 'transient block' results from temporary compression or concussion of the nerve A typical example is crutch palsy due to pressure on the radial nerve in the axilla. The paralysis is usually incomplete and full recovery occurs in a few days

A 'lesion in continuity' is seen most commonly when the radial nerve is crushed as a result of fracture of the shaft of the humerus

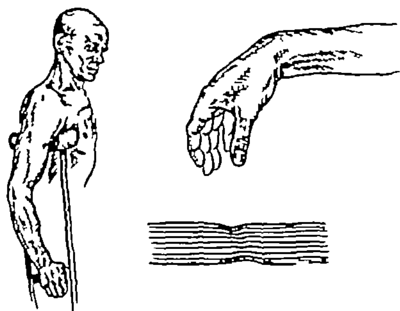


FIG. 27 Transient block of conduction in radial (musculo-spiral) nerve from crutch pressure.

The axis cylinders are damaged and undergo degeneration but since the supporting structures (*endoneurium, perineurium and epineurium*) remain intact regeneration proceeds smoothly and quickly and is complete within a few months.

Division of a nerve, partial or complete usually results from an open wound, or occasionally is caused by a sharp spicule of bone from a fracture. The peripheral stump undergoes Wallerian degeneration, while on the central side a limited amount of retrograde degeneration also occurs. Then within a few weeks the regenerative process begins. The axis cylinders sprout out from the central stump and if they

reach the distal sheaths progress distally at the rate of about a centimetre a week. If there is a gap between the two ends, however the thwarted axons form a tangled mass at the site of injury the so-called end bulb or neuroma. Even under the most favourable conditions many axons fail to bridge the gap Moreover, the junction between axons and sheaths is quite haphazard so in a mixed nerve inevitably some motor axons grow into sensory sheaths—and *vice versa*—and remain ineffective. Consequently after division of a nerve complete return of function cannot be expected and in mixed nerves such as the median and sciatic a very considerable paralysis usually persists.

Paralysis from Nerve Injury In the case of a mixed nerve the paralysis is as follows —

(1) Muscular Paralysis. The muscles supplied by the nerve are paralysed and flaccid They rapidly atrophy and in from four to

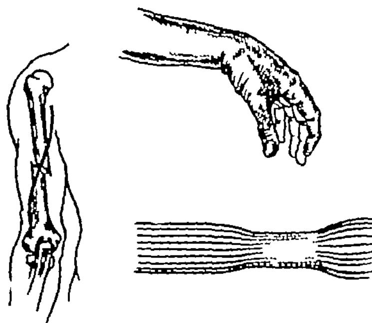


FIG. 23. Lesion in continuity of radial (musculo-spiral) nerve, due to fracture of humerus.

fourteen days they show the *Reaction of Degeneration* At this stage short electrical stimuli (of the order of 0 8 milliseconds) cause no contraction, because they act by stimulating the nerve. However long stimuli (of the order of 100 milliseconds) remain effective, for they act directly on the muscle, causing a slow heaving contraction. Eventually the muscles lose their contractile power and become converted largely into fibrous tissue and fat. The unparalysed muscles, now unopposed, may cause permanent deformity unless checked by suitable splintage.

(2) Sensory Paralysis. Most adjoining sensory nerves overlap and consequently the paralysis following nerve section does not extend to the full limits of the nerve's territory Anæsthesia (as tested by cotton wool or a camel hair brush) is lost over the greatest area. Pain sensation,

as tested with a pin, is lost to a smaller extent. Joint sense is carried by fibres in the motor nerves and is lost within a very small field, for example, in complete ulnar paralysis only the terminal finger joints are affected.

(3) Vasomotor Paralysis. Many mixed nerves carry autonomic nerve fibres, and division of them leads to vasomotor changes with blueness and coldness of the limbs and perhaps slight œdema

(4) Trophic Changes. In some cases the skin becomes thin and glossy and liable to pressure ulcers The nails become striated and brittle and the hair is coarse.

Treatment of Nerve Injuries Whatever the nature of the injury certain measures are necessary to maintain the function of the part until regeneration has occurred Stretching of the paralysed muscles must be prevented by appropriate splinting and disuse atrophy prevented by

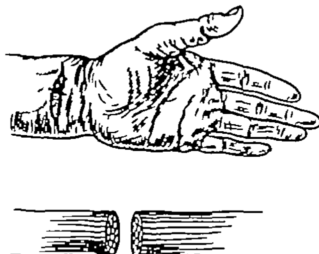


FIG 29 Open division of median nerve in wound of wrist.

massage and electrical stimulation. *All joints in the affected part should be put through a full range of movement daily* Care is needed to protect anæsthetic areas from injury

When a nerve has been divided the ends must be joined by suture. Primary suture may be carried out if the wound is seen early is not grossly contaminated, and is expected to heal by first intention As a general rule, however it is wiser to leave the nerve untouched at this stage. Later in a few weeks time, when the wound is completely healed, the nerve is exposed by a fresh incision, and secondary suture is carried out. Nothing is lost by a delay of this order and the serious risk of infection is obviated.

The nerve ends are exposed through a generous incision, and the end bulbs sliced off with a razor The two ends are laid in accurate apposition, without rotation and joined by the finest possible silk sutures, introduced through the sheath only (Fig 30) Tension on the suture line is obviated by flexing the limb or in the case of the ulnar nerve, by transposing it to the front of the elbow

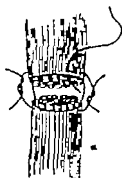


FIG. 30. Nerve suture. The nerve ends are approximated without rotation and held by fine silk sutures through the sheath.

Causalgia. In partial lesions especially of the median and posterior tibial nerves, a burning pain of a most intractable character sometimes develops. The pain, which is felt diffusely in the area of distribution of the nerve, is aggravated by the slightest touch, so that the patient guards the limb jealously and shrinks from contact. There is marked hyperæsthesia, while the part may be swollen, shiny and red. The severity of the pain leads ultimately to neurosis.

The nature of causalgia is not fully understood A recent theory attributes it to a breakdown of insulation between sympathetic and sensory nerve axons at the point of injury, allowing an "artificial synapse" whereby action currents travelling down the sympathetic fibres are picked up by adjacent sensory fibres. The treatment is to perform sympathectomy

Injuries of Individual Nerves

Cranial Nerves. See p 242

Brachial Plexus. *Tear of the Whole Plexus* This injury results from shrapnel or high explosive wounds or from severe wrenching forms of injury The whole limb is paralysed and is anæsthetic except for the distribution of the supraclavicular nerves over the shoulder Horner's syndrome (enophthalmos, narrowing of the palpebral fissure and contraction of the pupil) may be present owing to interruption of the sympathetic fibres carried in the 1st thoracic nerve root.

Upper Plexus Type of Injury (Erb-Duchenne paralysis) This is an injury to the upper trunk of the plexus or to the 5th and 6th roots. It may occur as a birth injury (Fig 31) from forcible depression of the shoulder by excessive traction, or it may follow a severe blow or a fall on the shoulder Generally the upper trunk is torn at or near 'Erb's point, where the trunk divides into its constituents. There results a paralysis of the abductors and external rotators of the shoulder (deltoid and spinati) and of the flexors of the elbow (biceps, brachialis, brachioradialis) with inconstant paresis of other muscle groups. The arm hangs in the porter's tip position. The shoulder is angular owing to atrophy of the deltoid, and cannot be abducted or rotated laterally Flexion and supination at the elbow are limited.

Lower Plexus Type of Injury (Klumpke paralysis) This injury to the lowest trunk of the plexus, usually due to birth injuries, is now rare.



Fig. 31 Birth injury to brachial plexus (Erb-Duchenne paralysis).

The treatment of brachial plexus injuries is unsatisfactory Attempts to suture the torn nerves are usually unsuccessful. The limb should be immobilised in such a position as to relax the paralysed muscles. In partial lesions some improvement may take place, but almost always there is some residual weakness. This can sometimes be reduced by appropriate orthopædic treatment. In the upper arm type of lesion, for example, the functional result may be improved by arthrodesis of the shoulder

The Axillary (Circumflex) Nerve. This nerve is liable to injury as

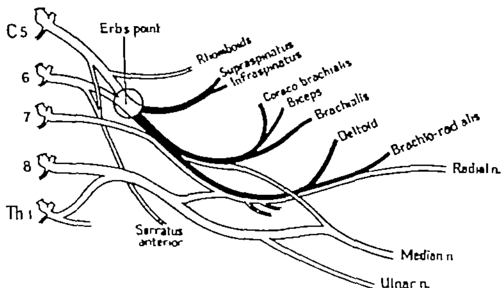


Fig 32. Brachial plexus, showing the nerves involved by an injury at Erb's point (Erb-Duchenne paralysis)

it winds round the neck of the humerus, through the quadrilateral space. It may be crushed in dislocation of the shoulder or fracture of the neck of the humerus, or in attempts to reduce those displacements. The deltoid atrophies, the shoulder becomes angular and the acromion becomes unduly prominent. Abduction is markedly impaired. There is a small area of anæsthesia over the insertion of the deltoid

The treatment is to fix the arm in 90 degrees abduction by means of a splint and to institute massage and galvanism. Some improvement is to be expected in most cases, and, in addition, the defect is com pensated by hypertrophy of the other abductors In a few cases arthrodesis of the shoulder may subsequently prove necessary

The Radial (Musculo-spiral) Nerve. This nerve may be injured (*a*) in the axilla, *e.g* by crutch pressure (*crutch palsy*) or by dislocation of the shoulder or (*b*) in its spiral course in fracture of the shaft of the humerus In this latter type the injury is usually a simple lesion in continuity occasionally the nerve is torn by a sharp fragment of bone or subsequently involved in scar or callus.

The extensors of the wrist and fingers and the supinators are para lysed and complete drop-wrist results. The hand grip is weakened owing to loss of synergic dorsiflexion at the wrist. If the nerve is injured in the axilla the triceps is also affected There is no sensory loss unless the injury is above the origin of the external cutaneous branch (dorsal cutaneous nerve of the forearm) when there is a small area of anæsthesia in the region of the index knuckle.

The treatment in the first place is to keep the wrist dorsiflexed in a splint and to institute massage and galvanism. In paralysis due to contusion, these means nearly always suffice and full recovery may be obtained, though it may take several months.

In cases of permanent paralysis great functional improvement may be obtained by tendon transplantation. The tendon of the pronator teres is detached from its insertion and stitched to the paralysed radial extensors of the carpus to assist dorsiflexion of the wrist the flexor carpi radialis is transplanted into the abductor and extensors of the thumb to improve the hand grip function, and the flexor carpi ulnaris is transplanted into the extensors of the fingers to take on the action of these muscles

The Median Nerve. This nerve is most liable to injury at the wrist or at the elbow

(*a*) *An injury at the wrist* causes both sensory and motor paralysis. Sensation may be lost over the palmar surface and distal part of the dorsal surface of the thumb and lateral two and a half fingers, and over the radial half of the palm (Figs 83 84) though often the area is smaller through overlapping

The motor paralysis affects the lateral two lumbricals and the thenar muscles—opponens pollicis, abductor brevis and flexor brevis, though the last named is often supplied by the ulnar nerve. Weakness of the short abductor is the most consistent sign. It is tested by raising the thumb vertically with the hand held palm uppermost (Fig 85)

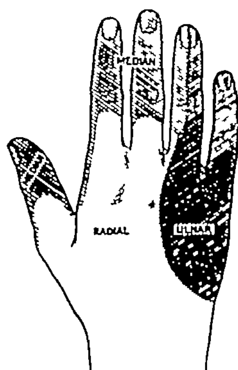


Fig. 33. Innervation of the hand; dorsal aspect.

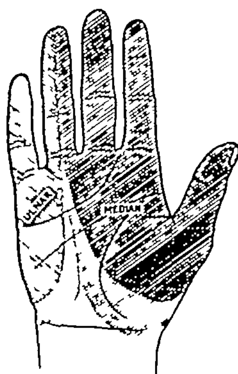


Fig. 34 Innervation of the hand palmar aspect. The dark hatching indicates exclusive innervation the light hatching indicates the intermediate zone of overlapping.

(*b*) An injury at the elbow causes the same sensory loss. The motor paralysis is increased by involvement of the pronator teres, the radial flexor of the carpus and the long flexors of the thumb index and middle fingers.

Trophic changes occur in the affected fingers especially the index, which becomes thin pointed and shiny The index and middle fingers

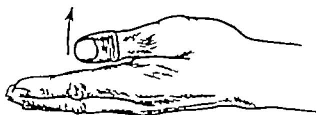


Fig. 35 Testing short abductor of thumb as evidence of median nerve paralysis.

become hyperextended at their metacarpo-phalangeal joints An injury of the median nerve is especially prone to give rise to causalgia.

The Ulnar Nerve. The ulnar nerve is liable to the following injuries

Division in open wounds at the wrist. There may be sensory loss on the anterior aspect of the little finger and half the ring finger and

on the corresponding part of the palm, though the area is often less owing to overlap If the dorsal cutaneous branch is injured the posterior aspect is likewise affected

The motor paralysis involves nearly all the intrinsic muscles of the hand on the ulnar side of the flexor pollicis longus—the interossei, the

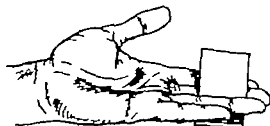


FIG. 36. Paper test for interosseous muscles in ulnar nerve paralysis.

medial two lumbricals, the muscles of the hypothenar eminence the adductor pollicis and the palmaris brevis To test for ulnar nerve damage, use the paper test (Fig 36) Note that the fingers must be kept fully extended otherwise the long flexors will act as adductors too Later partial clawing of the hand develops, with hyperextension of the metacarpo-phalangeal joints of the little and ring fingers and flexion of



FIG. 37 Claw hand, resulting from an injury to the ulnar nerve.

the interphalangeal joints. The hypothenar eminence is atrophied and the hand flattened.

The treatment is to expose and suture the cut nerve ends and to prevent deformity by splintage.

Division or compression at the elbow This type of injury occurs in

open wounds at this level or as a complication of fractures in the elbow region

The sensory loss is the same as in a lesion at the wrist The motor loss is increased by paralysis of the flexor carpi ulnaris, leading to radial deviation of the hand The medial part of the flexor digitorum profundus is also paralysed and consequently the terminal phalanges of the little finger and ring finger remain extended

Late ulnar neuritis This affection develops years after a fracture of the lateral condyle of the humerus, and is due to the nerve being stretched or compressed against the medial condyle owing to the development of cubitus valgus deformity The effects are the same as in (*b*) above, but are of gradual onset and not necessarily complete

The treatment is to transpose the nerve to the front of the medial condyle to lie in a bed prepared for it in the common flexor origin, where it will be protected from trauma.

Recurrent dislocation of the ulnar nerve Normally the nerve is retained in position behind the medial epicondyle by a band of deep fascia. If this retaining band is lost the nerve may dislocate during sudden movements of the elbow and give rise to sudden disability and pain The nerve is easily replaced, but difficult to retain in position. The treatment is to transpose it to the front of the medial condyle.



FIG. 38 Drop foot, due to neuritis of the common peroneal nerve. Note the prominence of the tibia, due to atrophy of the tibialis anterior muscle.

The Common Peroneal (Lateral Popliteal) Nerve. This nerve is liable to injury as it winds round the neck of the fibula. It may be divided in wounds of this region or compressed by splints or tight bandages. The tibialis anterior the extensor muscles of the toes and the peroneal muscles are paralysed and a drop foot results (Fig 38) Sensation is lost over part of the dorsum of the foot. If the injury involves the large cutaneous nerve that arises at the level of the neck of the fibula, the lower lateral part of the leg is also anæsthetic.

The treatment, if the nerve has been divided, is to expose and suture the cut ends of the nerve. In all cases the paralysed muscles must be relaxed by keeping the foot dorsiflexed to a right angle in a splint. The muscle tone must be maintained by massage and galvanism. If the paralysis persists great benefit is obtained by fitting a boot with a toe raising spring

in minute end organs in the skin or form a plexiform or diffuse thickening in the skin

Generally no treatment is required If one of the tumours attains large size, or becomes very pedunculated, it may cause disability and should be excised

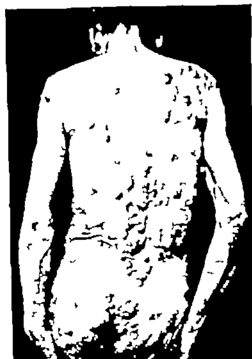


Fig. 40 Neurofibromatosis in a man aged 67 years. The disease had caused no disability

Ganglioneuroma. This is a tumour of autonomic nerve cells and is characterised microscopically by the presence of large nerve-ganglion cells It generally arises from the autonomic ganglia and plexuses in the mediastinum or abdomen or from the adrenal medulla (which is a derivative of the autonomic system) It is commonest in children but may occur at any age.

Amputation Neuroma. This is not a neoplasm but a physiological over growth of axon cylinders at the cut end of a nerve. It is symptomless unless involved in scar tissue or exposed to pressure, when it may give rise to severe and persistent pain, often referred to the phantom limb On examination an area of excruciating tenderness is found over the line of one of the superficial nerves, and in some cases a tender swelling is palpable close to the amputation scar

In performing amputation, to avoid the risk of a neuroma, the nerves should be dissected up crushed, ligated and divided as high as possible. Even small nerves like the digital nerves of the fingers should be treated in this way

The treatment of an amputation neuroma is to resect it along with a few centimetres of the nerve.

ANTERIOR POLIOMYELITIS (Infantile Paralysis)

This is an infectious disease due to a virus, which gains access in the upper air passages, and from thence spreads directly to the meninges and thus to the brain and spinal cord. It leads to perivascular lymphocytic infiltrations in the nervous tissue, especially in relation to the cells of the anterior grey columns of the spinal cord The paralysis at first is

very extensive, owing to the widespread œdema. Later the œdema subsides and much muscle power is regained, but there may be a residual paralysis of varying degree.

The disease occurs sporadically and occasionally assumes epidemic form. Most cases occur during the summer and autumn months. The susceptibility to the disease is greatest in childhood—hence the name infantile paralysis—but is not confined to that period. Even in childhood, moreover, only a small proportion of individuals are susceptible—2 per cent. or less.

Clinical Features. After a period of incubation varying from a few days to a few weeks, the disease starts acutely with symptoms like those of other fevers. The temperature is raised to 100° or 105°F., pulse and respiration rates are increased, and there are headache, nausea, vomiting and perhaps diarrhœa.

At this stage the diagnosis may be suggested, especially during epidemics, by pains in the trunk and limbs, widespread skin hyperæsthesia, muscular tenderness, and in some cases meningitic symptoms, such as neck stiffness and Kernig's sign.

The paralysis appears on the second to fourth day. In severe cases it causes complete loss of power in the lower and sometimes the upper limbs. The trunk muscles may also be involved, the bladder may be paralysed, and in extreme cases the intercostal muscles, and even the diaphragm, are paralysed. Recovery from the paralysis soon begins, and nearly all the recovery to be expected is attained by the end of six months.

Atypical Forms. Whilst the clinical features in typical cases are as described above, there are many cases with atypical features. On the one hand there are cases with ataxia, nystagmus and other signs of cerebral or cerebellar involvement; on the other hand there are abortive cases in which no paralysis develops.

Treatment. During the acute phase the customary treatment for any fever is adopted. Administration of serum from convalescent cases has been advised, but its value is doubtful. Repeated lumbar puncture seems to be useful to diminish the intraspinal pressure. If the bladder is paralysed, catheterisation is necessary. In cases involving intercostal muscles and/or the diaphragm, artificial respiration must be carried out in a respirator until the initial paralysis diminishes.

When the acute phase is past the extent of the paralysis must be gauged and steps must then be taken to encourage recovery and prevent deformities. It is essential to keep the paralysed muscles from being stretched by the opposing unparalysed muscle groups. For this purpose the patient must be kept in bed until all possible recovery has been attained, and during this time the weaker muscles must be protected by posture and splintage. If the trunk is affected, the patient is kept supine. If, as often happens, the abductors of the hip are affected, the thighs must be kept in wide abduction. Contractures of the knee, ankle and other joints must be prevented by splintage. In addition the muscle tone must be maintained by heat, massage, electrical treatment and muscle training.

Later, when the patient is allowed up, the paralysed limbs must be supported by suitable apparatus If the trunk muscles are affected a spinal brace and corset are worn if the shoulder muscles (particularly the deltoid) an abduction splint if the muscles controlling the knee, a calliper splint, if the anterior muscles controlling the ankle, a drop-foot splint, if the peroneal muscles, a medial iron fitting into the heel of the boot.

Operative Treatment. Operation is indicated in certain cases to counteract the residual paralysis, or to correct secondary deformities The former object is best achieved in most cases by tendon transplantation or by arthrodesis. Thus, in paralysis of the wrist extensors, tendon transplantation gives valuable results (p 68) in deltoid paralysis the shoulder should be fixed by arthrodesis in paralysis of the leg muscles the foot may be stabilised by operations designed to ankylose the tarsal joints.

These and other operations are referred to in the regional chapters.

SPASTIC PARALYSIS

This condition results from injury or disease of the upper motor neurones in the cerebral cortex. It is characterised by spasticity and hypertonus of the affected muscles and by exaggeration of the reflexes. It gives rise to severe disablement, difficult to treat. In most cases the cause is a birth hæmorrhage.

The mental state is often impaired, varying from slight emotional instability to complete idiocy In many cases there are involuntary athetoid movements of the affected limbs and face, which are exaggerated on effort or emotion.

The paralysis may affect any or all the limbs (monoplegia, diplegia, paraplegia) The affected muscles are spastic and held in rigid hypertonus there is no wasting and the reaction of degeneration is absent. The reflexes are exaggerated. The spastic muscles readily undergo contracture and lead to deformities (Fig 41)

Treatment. Much may be done by muscle re-education and training to overcome the tendency to spasm. The treatment is best carried out in a special clinic, and should be started as early as possible. Muscle spasm is inhibited by a hot bath The child is then instructed to breathe deeply in order to relax, and gentle passive movements are carried out, beginning with the



FIG. 41 Spastic paralysis resulting from a birth injury The imbecile expression is evident. Note the adduction deformity of the thighs.

larger joints such as the shoulder In this way the child gradually learns to carry out normal movements without jerkiness

Later control of the finer movements of the hands and feet and the facial muscles is taught.

If at the beginning of treatment there are fixed deformities due to contractures, they should be overcome by passive stretching In the more severe cases operation may be indicated to remedy an existing deformity or to correct the balance between the spastic muscles and opposing groups.

The usual type of operation is to divide the contracted muscles or their tendons. In the case of adduction spasm at the hip in addition to dividing the adductors it is customary to divide the obturator nerve completely or in part.

The procedures suitable for special types of case are described in the regional chapters.

THE SURGERY OF THE AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system controls the plain muscle fibres of blood vessels and viscera and the secretion of glands. It also transmits visceral afferent stimuli

The cerebral centre of the autonomic nervous system is situated in the hypothalamus, in close relationship to the tuber cinereum. From thence two antagonistic sets of fibres pass to the periphery—the sympathetic and the parasympathetic nerves.

The Sympathetic Nerves. Sympathetic stimuli from the hypothalamus pass through three series of nerve cells in their progress to the viscus, gland or vessel they supply The axons of the hypothalamic cells extend down the cord and terminate in the lateral columns of grey matter In the lateral columns they arborise round cells known as connector cells. The axons of these connector cells are the preganglionic fibres. They leave the cord as white rami communicantes, emerging in the anterior roots from the thoracic and upper two lumbar segments. They then pass directly into the ganglionated sympathetic trunks and terminate in one of the following ways (1) they may arborise round a ganglion cell in the nearest ganglion (2) they may pass through one or more ganglia upwards or downwards in the trunk before arborising· (3) they may pass through one or more ganglia and enter one of the splanchnic nerves and terminate by arborising round ganglion cells in the visceral ganglia, e.g the coeliac or mesenteric ganglia lying in front of the aorta.

The cells in these ganglia are known as the excitor cells, and their axons are the postganglionic fibres. These fibres may proceed to the head by way of the cervical sympathetic trunk and along the internal carotid artery to the limbs as grey rami communicantes in the mixed nerves or to the viscera *via* the various plexuses along the visceral arteries. They terminate in relation to the plain muscle or the blood vessel or the gland.

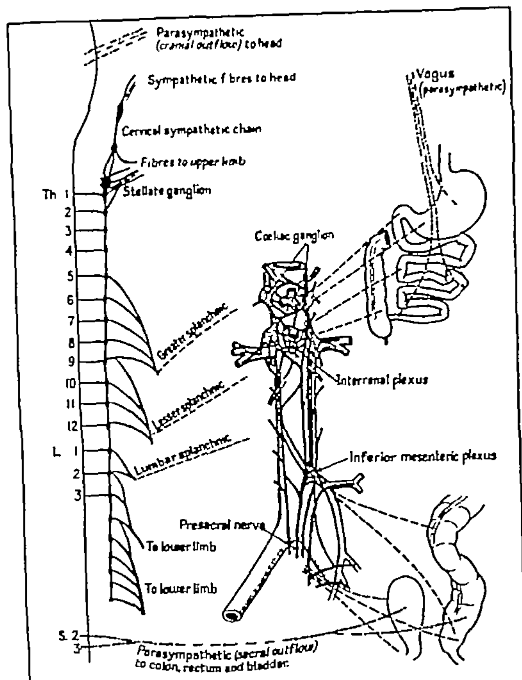


FIG. 42. Autonomic nerve supply to the viscera.

The sympathetic nerves are known as *adrenergic* from the fact that they act by secreting adrenalin at their terminals. In general, they are vasoconstrictor in action, and in the viscera their usual effect is to contract sphincter muscle fibres and to relax the remaining portions of the muscle coat. In relation to the hollow viscera they are *sometimes* known as the " filling nerves.

The Parasympathetic Nerves. These nerves pass to the periphery by two channels, (*a*) the cranial outflow along the oculomotor facial, glossopharyngeal and vagus nerves (*b*) the sacral outflow, along the

so-called nervi erigentes from the second, third and fourth sacral segments of the cord. The preganglionic fibres terminate close to the peripheral structure consequently the postganglionic fibres are short.

Parasympathetic nerves are known as *cholinergic* from the fact that they act by secreting acetyl-choline at their terminals. In certain regions they are vasodilator in action and in the viscera their usual effect is to contract the muscle coat and relax the sphincter muscle fibres For this reason they are sometimes known as the "emptying nerves."

Indications for Sympathectomy Sympathectomy was recommended formerly for many obscure diseases, but its limitations are now recognised and it is only advised on clear indications. It is of greatest value in vascular diseases and in certain types of severe pain (causalgia) following nerve injuries. Among vascular diseases, those of the upper limb, e.g Raynaud's disease, benefit most. In the lower limb the improvement is greatest where the collateral vessels are healthy and capable of dilatation.

Methods of Sympathectomy Three methods are in general use

Cervical sympathectomy is used for affections of the upper limb and occasionally for affections of the head and neck The earlier operation



FIG. 48. Horner's syndrome after resection of the stellate ganglion.

was to remove the stellate ganglion This gives rise to enophthalmos (Horner's syndrome) The preferable operation, which avoids this deformity is to divide the preganglionic nerves as they come from the first and second thoracic roots. In the anterior approach an oblique incision is made in the lower part of the posterior triangle of the neck,

the sternomastoid and, at a deeper level the scalenus anterior are retracted forwards and partly divided, and access is gained between the subclavian artery and Sibson's fascia In the posterior approach with the patient prone, a vertical incision gives access to the third rib and transverse process, which are resected

Lumbar sympathectomy is used for affections of the lower limb The operation consists in removing the ganglionated lumbar chain, generally from the level of the second ganglion downwards. An extra peritoneal route is taken as for exposure of the ureter the peritoneum is displaced medially and the trunk is exposed as it lies deep to the lateral margin of the aorta or vena cava.

Lumbo-dorsal sympathectomy or *splanchnicectomy* was used formerly for hypertension. It comprised division of the three splanchnic nerves and the dorso-lumbar ganglionated chain on both sides. Nowadays a similar effect is achieved by administering ganglion blockade drugs.

For technique of injection into sympathetic trunks see p 84

CHAPTER 12

THE BLOOD VESSELS

HÆMANGIOMA

A HÆMANGIOMA is a tumour derived from endothelial cells of blood vessels It may be solid or may contain blood channels, which may or may not be connected with the circulation.

Hæmangiomata are generally congenital in origin, and are found most often in the skin or subcutaneous tissues, especially of the face. Nearly all are benign The following types are recognised —

Capillary Hæmangioma. This tumour contains dilated channels lined by endothelium, and thus having the structure of capillaries. The channels do not originally communicate with the circulation and are empty and collapsed later they may acquire a communication.

There are three main types of capillary hæmangioma —

(a) The cutaneous hæmangioma, "mother's mark or "port wine stain occurs most often on the face. It is red or purplish in colour and may be of large size. It is very disfiguring and, unlike other hæmangiomata, does not tend to disappear It may be treated by painting repeatedly with thorium oxide, which emits beta rays Or a mixture of titanium oxide and other powders may be tattooed into the dermis superficial to the angioma in order to mask it. In some cases the blemish can be concealed by cosmetics.

(b) The 'spider nævus' (nævus araneus) is a small collection of dilated capillaries shaped rather like a small bodied spider It is best treated by the actual cautery

(c) The subcutaneous hæmangioma consists of connective tissue containing large vascular spaces It forms a well-circumscribed tumour which may be encapsulated. Generally it is bright red, like a raspberry and is then easily diagnosed. It may enlarge rapidly, or it may retrogress and disappear during adolescence. It may be treated by radium applications, or failing that, by electrolysis.

Compact Hæmangioma. *This is a solid or sometimes partly* cystic tumour composed of solid masses of cells derived from primitive angioblastic tissue. It may arise in the subcutaneous tissues or in viscera such as the kidney It is generally of benign type, and in the subcutaneous tissues it closely resembles the capillary angioma in its clinical features In the viscera it may be simple or malignant.

Cavernous Hæmangioma. This is usually a capillary hæmangioma distended by blood from the general circulation. It may occur in the skin or subcutaneous tissue or in a viscus such as the liver In the integuments it forms a soft, rounded tumour often purplish in colour and slightly compressible. Its size may remain stationary or may

slowly increase If treatment is necessary, the tumour may be excised by operation

Cirsoid Aneurysm (Arterial Angioma) This rare condition may occur in infancy or adult life. In some cases it appears to be traumatic in origin It consists of an overgrowth of arteries which are greatly dilated and intertwined in racemose fashion The arteries pulsate visibly like a pulsating mass of earthworms. It is most commonly found in the branches of the superficial temporal artery, and may



Fig 44. Cirsoid aneurysm of the superficial temporal artery It was attributed to an injury sustained many years previously

give rise to a loud subjective bruit, which is very distressing and may interfere with sleep

The condition may be treated by excision of the dilated vessels Hæmorrhage is formidable, but may be controlled by deep stitches inserted temporarily around the tumour and by preliminary ligation of feeder arteries.

ARTERIAL INJURIES

Hæmorrhage from Arterial Injury When even a large artery is completely torn across the hæmorrhage is not necessarily severe, for the torn intima is able to retract, and this, with spasm of the muscle coat, may occlude the lumen. This is especially so if the artery has been divided by torsion. For example, if a limb caught in moving machinery is wrenched off the hæmorrhage may be minimal.

On the other hand, a lateral wound bleeds freely for as the intima retracts the opening enlarges. A lateral wound of a major artery may cause fatal hæmorrhage.

If the wound in the skin is small or valvular an *arterial hæmatoma*

results, which gradually becomes circumscribed to form a *traumatic aneurysm* The vein accompanying the main artery may also be wounded, and an *arterio-venous aneurysm* will then result (p 90)

The local treatment of external hæmorrhage from a large artery is described on p 40 As an emergency measure, if possible the bleeding should be controlled by packing the wound and bandaging the pack firmly in position. A tourniquet should be applied only if the bleeding is formidable and should not be kept in position longer than an hour or so lest the vitality of the limb be imperilled As soon as possible the bleeding vessel should be exposed and controlled by forcipressure and ligation.

Injury to Main Artery of Limb When such a main artery is suddenly occluded, whether by wounding or by pressure from a hæmatoma or a displaced bone, or by embolism the limb becomes ischæmic. This may lead to gangrene of the whole limb or to less severe consequences depending on the collateral circulation. If the ischæmia is complete, the extremity becomes pulseless and dead white, and gradually cools to the room temperature. Later the pallor gives way to cyanosis, due to dissociation of oxyhæmoglobin in the skin vessels, while an appearance of marbling results from staining of the walls of the superficial veins. Later the limb becomes purplish and finally black.

When, on the other hand, a collateral circulation develops, gangrene may be averted, but even so the temporary ischæmia may lead to contracture of muscles (p. 147) to anæsthesia of glove or stocking distribution and to permanent weakness of the limb

Where compression of a main artery is suspected the cause of the compression must be dealt with at once. In some cases it is advisable to expose the artery to relieve pressure In addition, the following measures are required to avert the consequences of ischæmia.

(1) Measures to increase the flow of blood through collateral channels. If as is usual the patient is in a state of shock, a copious blood trans fusion (4 pints or more) should be given promptly to raise the blood pressure to normal. Warmth may be applied to the trunk to cause a general vasodilatation. A sound sleep the most natural and effective vasodilator should be ensured by full doses of morphine (gr ¼ given four hourly) Alcohol may be useful Some surgeons advise the use of papaverine of which gr ½ may be given intravenously every two hours If arteriospasm is suspected, a procaine sympathetic block is sometimes advised (see p 84) Alternatively sympathectomy may be performed.

(2) Measures to be applied locally to the ischæmic limb The limb should be immobilised comfortably in a Thomas' splint or a Cramer wire splint, and elevated a few inches. Plaster of Paris should not be applied The limb should be kept cool and dry by exposure to the air In the tropics, ice bags may be suspended near the limb By these measures the tissue metabolism is kept at a low level and its oxygen requirements minimised.

OBLITERATIVE VASCULAR DISEASE

This term covers several conditions of diverse ætiology and microscopic appearance all characterised by gradual narrowing of arteries. It includes arteriosclerosis, atheroma, syphilitic and diabetic arteritis and thrombo-angiitis. From the surgical point of view, however, they have much in common, and it suffices to recognise two main groups, typified by arteriosclerosis on the one hand and thrombo-angiitis on the other Even these are not entirely distinct, so having mentioned the features in which they differ we can proceed to discuss the subject of obliterative disease as an entity

Arterio-sclerosis is common in elderly persons It is a slowly progressing disease which tends to affect the arterial system as a whole, so while the symptoms for which treatment is sought may refer to a

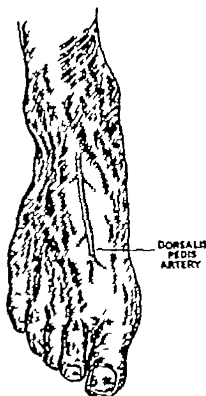


FIG. 45 Site of dorsalis pedis artery

single part (e.g claudication in one calf, or gangrene of a toe) we may expect to find less advanced degrees of the disease elsewhere. For example, the collateral circulation in the affected limb may be impaired, and the vessels of the other limb also while there may be disease affecting the coronary arteries or the cerebral vessels. Moreover we are dealing with ageing patients and struggling against the tide of life. Nevertheless there are many patients in whom the local lesion predominates, so that surgical treatment may offer the chance of prolonged benefit.

Thrombo-angiitis occurs typically in younger men, generally under 60 and occasionally under 80 It is rare in women. There are inflammatory changes in the walls of the arteries, with thrombosis within

PLATE I



Arteriogram. The femoral



Obliteration of popliteal



[illegible] of anterior and



Marked narrowing of anterior

PLATE II



A

Traumatic aneurysm of femoral artery due to wound with butcher's knife.



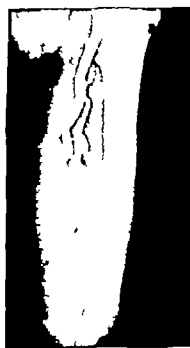
B

Aneurysm of common carotid artery, treated by excision of the sac and lateral repair of the artery



C

Obliteration of terminal part of aorta (Leriche's syndrome), with collateral circulation.



D

Traumatic arterio-venous aneurysm. Diodine outlines the femoral artery above, the circular aneurysm cavity and, below the dilated veins.

test, dryness of the skin of the affected limb will provide proof that the sympathetic block has in fact been achieved

Sympathetic blockade may also be brought about by the injection of ganglion blockade drugs such as methonium which interrupt conduction at the ganglionic synapse

Clinical Types of Obliterative Vascular Disease

(1) In the common type the disease is widespread, chronic and slowly progressive, affecting both lower limbs though seldom equally The symptoms fall into two categories. If the muscle blood flow is mainly involved there is claudication, with cramping pain, usually in the calf muscles, coming on after walking a short distance and bringing the patient to a sudden halt. If the skin blood flow is mainly involved the feet are cold there is resting pain due to ischæmia of nerve endings, the skin is pallid or blue, and intractable ulcers may develop

Treatment depends on the age, the general condition and the degree of structural change in the vessels Often only conservative treatment is possible; warm underclothing extra socks restriction of walking use of vasodilators (including alcohol) and sedation Lumbar sympathectomy gives valuable relief in younger patients with relatively good collaterals but is disappointing in elderly persons

(2) Thrombosis superimposed on arterial disease will convert a mild chronic disability into a severe illness. If the femoral artery is obstructed the whole limb may undergo massive gangrene. More commonly there is gangrene of a toe or part of the foot. The *treatment* in cases seen early, is to give anticoagulants and vasodilators, and keep the limb exposed and cool in the hope of averting gangrene. In later cases, amputation is needed (p 87)

(3) Much less commonly there is a segmental block involving a short length of a main artery, the rest of the arterial tree being but little affected. If the block is in a favourable site such as the femoral artery the collateral circulation may suffice to prevent gangrene, and the main feature is claudication which may affect particularly the thigh muscles Arteriography is useful in this type of case. In the *treatment*, sympathectomy is often valuable. In favourable circumstances an artery graft may be considered or even endarterectomy in which through minute incisions the diseased intima is cored out, leaving the elastic layer and adventitia within which a new endothelial lining may form.

(4) Rarely the disease has its main effect in the distal part of the aorta and the iliac vessels. This type gives rise to *Leriche's syndrome* of which the most notable feature is failure in sexual potency as the blood supply is insufficient to sustain an erection Little treatment is available in most cases, though occasionally a lateral by pass arterial graft has been practised.

lumbar spines, piercing the skin 7 cm. from the midline and passing medially at 45 degrees till it abuts against the side of the vertebral body when it is withdrawn slightly directed a little forwards and made to slide 1 cm. beyond the side of the body After confirming (by withdrawing the syringe piston) that no vessel is entered, 30 ml. of 1 per cent. procaine is introduced.

GANGRENE

Gangrene or necrosis may be defined as massive tissue death and may affect any part of the body including the integuments, connective tissues and bones and even the viscera. The term "gangrene" unqualified however, is usually applied to the condition as it affects the soft tissues of the extremities.

Gangrene results from interference with the blood supply to the part from injury or disease. Common causes are (1) wounds involving a major vessel (2) impaction of an embolus in the main artery of a limb (3) gradual narrowing of a main artery by obliterative disease, often finally complicated by thrombosis within the narrow lumen. Infection may precipitate or aggravate the gangrene in any of these examples. (Note that "gas gangrene," an infection by specific anaerobes, is in a different class.)

Senile Gangrene is a common end result of obliterative vascular disease in elderly persons It generally starts in one of the toes, and may remain limited or it may spread, in the course of months, to involve the forepart of the foot.

In the early stages the affected toe is cold and pale, then dead white, or a bluish area or a blister may appear Later the part becomes dry



FIG 40 Dry gangrene in man aged 74 with severe arteriosclerosis.

shrivelled and leathery and effused blood pigment discolours it brown and eventually black. In the course of time a line of demarcation may form between the dead and the living tissue, but the separation of the two is very slow owing to the diminished vascularity of the non-gangrenous part.

Treatment. Conservative measures are advisable for many old, feeble patients, especially if both feet are involved The foot is bathed in spirit and well powdered to keep it dry and aseptic and is protected by a cotton wool dressing At intervals during the day the foot is exercised, and the leg is periodically raised and lowered to promote an increase in the circulation. Pain, which is often severe, is generally relieved most readily by holding the limb dependent over the side of the bed *Heparin or dicoumarol may be of value* (p. 95)

Sympathectomy is often practised, and may be helpful if the collateral vessels are not diseased Usually however the benefit is small or transient.

If the pain is severe and exhausting amputation may be unavoidable. Formerly it was always advised to perform a mid thigh amputation, to ensure a good blood supply to the flaps Nowadays it is often safe to try an amputation at a lower level, for even if the flaps necrose there is, owing to antibiotics, no risk of sepsis, and a second operation no longer carries either the terrors or the dangers of former years. Thus a below knee amputation, a mid tarsal amputation or amputation of a single digit all now have a place in treatment.

Diabetic Gangrene should be termed Arteriosclerotic Gangrene in Diabetics' for arterial disease is always present, although not so marked as in senile gangrene. In addition, the diabetes causes a lowering of resistance to infection, and renders the gangrene more rapid in course and more liable to infective complications.

Diabetic gangrene occurs in persons over fifty years old It usually starts in one of the toes and spreads rapidly to involve the forepart of the foot and even the leg Since the process is rapid fluids are retained in the dead part and the gangrene is almost always of moist type, and in the great majority of cases is heavily infected

The treatment is primarily by antibiotics to control the infection and by insulin to control the diabetes. Later treatment is the same as for senile gangrene.

ARTERIAL EMBOLISM

An embolism impacting in the main artery of a limb is usually derived from a clot in the left auricle, formed as a result of auricular fibrillation. In rare cases the embolus originates from a thrombus adhering to a patch of atheroma in the aorta.

The embolus generally impacts at a bifurcation or at a point where a large artery gives off a major branch. Common sites for embolism are the femoral artery at the origin of the profunda femoris, the external iliac artery at the groin and the popliteal axillary and brachial arteries.

The symptoms are those characteristic of a sudden vascular obliteration (p 82) When the embolus impacts there may be severe cramplike pain, followed by tingling numbness and coldness of the limb Immediate examination shows the limb pale and cold. Its sensation is diminished, the muscles below the level of the impaction are paralysed and there is no pulsation in the peripheral arteries. Often there are tenderness and hyperæsthesia over the actual embolus.

Later the skin becomes pale, green waxy and translucent, while thrombosed superficial veins become evident. Then the usual signs of gangrene appear and the limb becomes purple and eventually black. The gangrene is generally dry at first, but may become moist.

Treatment. When the embolus is impacted in a major vessel such as the iliac artery or the aortic bifurcation embolectomy should be performed In the case of the iliac artery the artery exposed under local anæsthesia, is occluded temporarily by tapes and opened by a small longitudinal incision. The embolus is then removed, all secondary

clots are expelled by momentary release of the tapes, and lastly the arterial wall is closed by specially prepared fine silk sutures. Heparin is then given (p 95) Procaine block or sympathectomy (lumbar or cervico-dorsal) should be performed to improve the collateral circulation (p 84) An embolus in the aortic bifurcation can be removed through an incision in the common iliac artery

In smaller arteries, the preferable treatment is to rely upon anti coagulants (heparin at first, dicoumarol later) in the hope that if secondary thrombosis is prevented the collateral circulation will suffice.

In cases seen later, amputation is necessary It should be delayed as long as possible, infection being controlled by antibiotics, to allow a collateral circulation to develop If this is done, quite a limited amputation may suffice.

RAYNAUD'S PHENOMENON

When the body and extremities of a normal person are exposed to cold, the digital vessels contract and the blood flow through the fingers is greatly reduced Raynaud's phenomenon is due to an excessive response to cold It may be primary or idiopathic, or it may be secondary to disease of the vessels.

The primary or idiopathic variety occurs almost exclusively in women especially between 18 and 30 years of age. An inherited predisposition may be a factor The vessels show no organic disease, and the main feature is an excessive response of the digital arteries to local cooling

The secondary variety may be associated with arteriosclerosis affecting the digital arteries, or with narrowing of the main vessels at a more proximal level. This latter may be due to arterial disease or, rarely to the pressure of a cervical rib. The secondary variety also occurs in workers using vibrating tools such as pneumatic riveters, and is then probably due to spasm of the digital vessels

Whatever the cause, the symptoms of Raynaud's disease are most obvious in the winter months. On exposure of the hands to the cold, the fingers become cold, white and dead In severe cases these changes occur even under comparatively warm conditions. This " local syncope " may last for a few minutes or several hours. It may be followed by a period of reaction, with congestion of the fingers and severe pain. In some cases the veins by dilating permit stagnation of unaerated blood, and the fingers become blue, livid and painful (" local cyanosis ") In long-continued cases nutritional changes occur ulcers and atrophy of the pulp of the fingers, paronychia and other changes involving the nails. Rarely they may progress to superficial areas of gangrene.

The treatment in mild cases consists in protecting the fingers and hands from the cold Vasodilator drugs such as Tolazoline (Priscol) are at present under trial. In more severe cases benefit is obtained from resection of the sympathetic trunk below the stellate ganglion and thus interrupting vasoconstrictor control of the upper limb

Acrocyanosis This condition resembles Raynaud's disease but differs from it in being painless and non-paroxysmal It occurs mainly in young women and affects the fingers of both hands It is characterised by painless blue discoloration or cyanosis and by swelling of the soft tissues often with paræsthesia or partial anæsthesia. Trophic changes such as chilblains are common The cause is not fully understood In a few cases cervical rib pressure has been blamed. In the treatment, if simpler measures fail division of the sympathetic trunk gives valuable results

Erythromelalgia This rare condition occurs in either sex and mainly affects the feet. There is a burning pain in the toes or heel brought on by warmth by exercise or by the dependent position so much that the patient prefers to sleep with the foot exposed and elevated. During an attack the affected part is bright red and extremely tender like a burn of the first degree The treatment, if simpler methods fail is to perform lumbar ganglionectomy

Scleroderma This is a rare disease characterised by painless œdema and induration of the soft tissues, often with brownish discoloration of the skin It is thought to be a result of a prolonged vasospastic affection allied to Raynaud's disease. If simpler methods of treatment fail sympathectomy is said to give encouraging results.

BLOOD VESSEL GRAFTS

Three types of graft have been used to replace segments of a blood vessel.

(1) Autogenous vein grafts. The great saphenous vein is readily available and when transplanted it will " take " readily but unfortunately is not strong enough to resist the systolic blood pressure, so it cannot be widely used.

(2) Homogenous artery grafts of suitable size and shape can be taken from the cadaver preferably of healthy young adults dying from accidents. They are freeze-dried and preserved in ' artery banks at deep-freeze level. Unfortunately, being homografts, they do not really " take " but remain as foreign tissues within the host. The intima is rapidly replaced by a new endothelial lining from the host tissue, and the adventitia is removed gradually by phagocytosis and is replaced. Homogenous artery grafts may function well however for a number of years, but ultimately they tend to degenerate.

(3) Tubes made of woven plastic such as Orlon can be obtained in various sizes and shapes. They can readily be sterilised and they cause no foreign body reaction, and bid fair to replace natural tissues in this field of work.

Blood vessel grafting is indicated in only a few types of case, particularly where the large vessels are involved where the vessel wall is healthy above and below the graft, and where the collateral circulation is not alone adequate. Thus, an aneurysm of the terminal aorta may be excised and replaced by a cadaver homograft, or a segmental arterial obstruction may be replaced by an Orlon tube. Occasionally an Orlon by pass may be used to supplement a partly obstructed vessel instead of replacing it.

ANEURYSM

An aneurysm (Greek ἀνεύρυσμα a dilatation) is a sac or abnormal channel communicating with an artery and thus containing either blood or blood clot. An aneurysm may consist of a fusiform dilatation of an artery but more often is a saccular pouch leading off from one side of the artery Such a sacculation is walled in by fibrous tissue and often contains blood clot, the outer parts of which are old, tough and laminated

Traumatic Aneurysm. This condition follows a punctured wound of an artery, such as a stab or bullet wound The clot which forms round the puncture is hollowed out by the pounding of each systolic wave and comes to contain a spherical cavity which ultimately becomes lined by endothelium. As the aneurysm increases in size it causes pain It may compress the main vessel and collateral vessels and cause gangrene. This is especially apt to follow thrombosis within the aneurysm.

The treatment is by operation. In a favourable site such as the superficial femoral it is possible to remove the aneurysm and rely upon the collateral circulation to maintain the vitality of the limb Otherwise, after excising the aneurysm it is necessary to insert an arterial graft.

Arterio-venous Aneurysm. If a punctured wound involves a vein as well as an artery an arterio-venous aneurysm results. Such wounds most often affect the brachial carotid and femoral arteries. The communication between artery and vein may be direct or *via* an intermediate sac. The arterial blood is then forced under high pressure into the thin walled vein which becomes greatly dilated and pulsates. On auscultation over the part, a loud roaring bruit may be heard. In some cases so much blood is short-circuited through the new opening that the distal part of the limb becomes cold blue ill nourished and even gangrenous, while the heart undergoes compensatory hypertrophy and dilatation. In favourable cases the whole aneurysm, along with the affected parts of artery and vein, may be excised and if necessary replaced by an artery graft. Alternatively a ' four fold ligation may be performed

Arterio-venous aneurysm may occur in the intracranial part of the internal carotid artery where it constitutes one cause of pulsating exophthalmos (p 241) Rarely *congenital arterio-venous aneurysms* occur in the neck and limbs There are multiple small communications which cause great venous dilatation. Treatment is ineffective.

" Pathological ' Aneurysm. This type of aneurysm usually arises from the combined effects of syphilitic arterial disease and high blood pressure. Owing to the success of modern treatment for syphilis it is becoming rare. It presents a globular or fusiform swelling which pulsates and on auscultation gives a blowing murmur

Treatment To reduce the blood pressure the patient must be kept absolutely at rest in bed. Opiates are given for pain or to avoid restlessness

Operative treatment should be carried out in suitable cases for non-operative measures rarely do more than delay the progress of an aneurysm. The following are the more important of the many operations that have been devised —

(1) Extirpation of the aneurysm is the method of choice in notable cases especially in the limbs The whole sac is removed and all communicating vessels ligated Where the collateral circulation is judged to be sufficient, e.g in the iliac or femoral vessels, the main artery is ligated above and below Where the collateral circulation is insufficient, a graft is inserted to bridge the gap For aneurysm of the distal aorta (i e. below the renal artery) a cadaver homograft is used. In other cases an artificial prosthesis such as Orlon is now generally preferred

(2) At the root of the neck, where extirpation is not possible, proximal ligation of a main artery such as the subclavian may be attempted

VARICOSE VEINS

The saphenous veins of the lower limb lie unsupported in the subcutaneous tissue. Unlike the deep veins, they have no support from investing fibrous sheaths, and they lack the pumping action of the muscles of the calf and thigh Their blood flow is influenced markedly by gravity, and in the erect position only the tenuous valves protect them from the full force of a heavy column of blood extending up to the superior vena cava.

While the primary cause of most cases of varicose veins is not known it is clear that incompetence of the valves plays an important part. In a few cases the primary cause is obstruction of the deep veins due to phlebitis or the pressure of a pelvic tumour The pressure of the fœtal head during pregnancy may be responsible, either for initiating or at least aggravating the varicosities.

The great saphenous vein is affected in most cases It is dilated tortuous and pouched Sometimes its whole length is involved, from the medial side of the foot to the groin sometimes the changes are most marked below or above the knee· or there may be a single pouch (saphena varix) at the groin. Less often the small saphenous is affected on the back and lateral side of the calf or both systems may be involved together

Clinical Features

Varicose veins are often symptomless, or they may cause a heavy pain in the legs and œdema on prolonged standing Their main importance arises from their complications.

Pigmentation of the skin on the medial side of the leg results from leakage of red blood cells as a result of the venous stasis. The skin assumes a brown or purple discoloration. It may be very itchy

Rupture of a dilated saccule close above the ankle may lead to alarming hæmorrhage, which however is easily controlled by elevating the leg

Ulcer (varicose ulcer; gravitational ulcer chronic leg ulcer) may occur (see below)

Examination The patient is examined standing, so that the course and extent of the dilated veins can be observed.

The competence of valves at the groin may be tested by *Trendelenburg's test.* With the patient recumbent *the veins are emptied and a finger is* pressed upon the saphenous vein at its upper end. If the patient is allowed to rise, and then the finger pressure is released in the absence of a competent valve the vein will be seen to fill with a sudden rush of blood from above.

A search should be made for deep communicating veins which perforate the deep fascia to enter the femoral or tibial veins. Commonly there is one a *few inches above the knee, one just below the knee and* a third (often deep to an ulcer or patch of pigmentation) a few inches

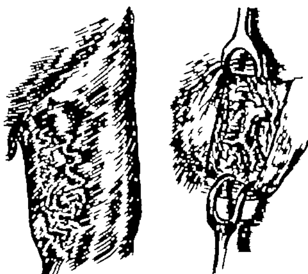


FIG. 47 High ligation of saphenous vein. The incision is in the fold of the groin. The saphenous vein is doubly ligated and divided close to its point of entry into the femoral vein, and all tributaries are ligated and divided.

above the ankle. Sometimes it is possible to identify them by feeling the hole in the deep fascia, but a better method is to empty the veins by posture, bandage the limb from groin to foot and then, with the patient erect, remove the bandage turn by turn As each connecting channel is uncovered the flow of blood superficially is observed.

Treatment. (1) The mainstay of all treatment, and particularly when (*as nearly always*) *the valves are incompetent,* is to break the column of blood by the operation of *High Ligation* (Fig 47) in which the great saphenous vein is divided close to its termination and all tributaries at this level also are divided If desired, this operation can be done under local anaesthesia in the ambulant patient.

(2) Supplementary to high ligation 5 ml of sodium morrhuate or other sclerosing solutions may be injected into isolated or persistent

pouches in the calf Injection treatment by itself is no longer employed

(3) In severe cases, in combination with high ligation, the veins may be exposed through a series of oblique incisions at different levels and the whole length or the more dilated portions excised

(4) The old *stripping operation* is now returning to favour The vein is exposed at the ankle and the flexible stripper inserted and guided up as far as the groin. A subsidiary incision may be needed at knee level to negotiate any obstruction At the lower end the vein is securely tied above the olivary head and divided below At the upper end the high ligation is done and the tip of the stripper is brought out at the wound With the limb elevated the stripper is then drawn upwards, avulsing the vein and tearing all its tributaries and connections. As the process goes on a crêpe bandage is applied from the ankle upwards. Finally the whole vein comes away the groin wound is closed and the bandaging completed The patient is kept in bed for about a week

(5) *Elastic stockings* are useful to supplement the above procedures.

Chronic Leg Ulcer, Varicose Ulcer, Gravitational Ulcer This very disabling chronic affliction occurs mainly in middle aged women. In the great majority of cases it is due to venous stasis consequent on varicose veins or deep phlebitis or both. Occasionally arterial disease contributes Very often immediately deep to the ulcer there is a deep communicating vein with deficient valves, and this probably determines the site of ulceration

Gravitational ulcer generally is situated just above the medial malleolus, very rarely on the lateral side. If very extensive it may encircle the leg The ulcer may heal from time to time but breaks down again and eventually becomes callous with a thick fibrous base. It suppurates and bleeds and causes chronic ill health from anæmia. It must be diagnosed from syphilitic ulcer (Fig 40)

There are three phases in treatment (1) to procure healing of the ulcer (2) to deal with the varicosities (3) to give support and exercises to prevent recurrence.

(1) To procure healing a period of rest in bed is most effective. If prolonged rest is not possible, a week or two in bed, with Eusol dressings, will diminish the infectivity of the ulcer The foot of the bed is raised and massage applied to dissipate œdema. After this phase, a plain vaseline gauze dressing is applied and a generous layer of fluffed-out wool to the whole limb from toes to knee, and finally a firmly applied bandage of heavy one-way stretch material The patient is allowed up and instructed to exercise the calf muscles to maintain a good venous return. The ulcer is dressed, and the bandage re-applied, once a week. If preferred a pad of sponge rubber may be applied over the ulcer to maintain constant pressure.

Using any of these methods, the patient must be instructed to rest with the foot elevated when possible, and when erect not to stand still but to exercise so that movement of the calf muscles inside the rigid bandage will prevent venous stasis and dissipate œdema.

(2) When the ulcer is healed the veins should be treated as discussed



FIG. 48. Chronic leg ulcer in patient with varicose veins. Note also the severe degree of flat foot.



FIG 49 Tertiary syphilitic ulceration, in a woman aged 60 years. There are multiple ulcers, characteristically situated over the upper outer part of the leg Note the extensive scarring and the coppery pigmentation.

above. Special care is taken of any " feeder " communicating vein near or deep to the ulcer

(8) Subsequently a viscopaste bandage should be used, and later an elastic stocking The exercises should be continued

Rupture of Varicose Vein. This complication results from necrosis of the tissues overlying a varix, or occasionally from an injury The hæmorrhage is alarming, for if the patient is standing the blood gushes out in a wide stream under high pressure, and it may be fatal The treatment, however is simple and effective, for the bleeding can be arrested immediately by elevating the limb and applying direct pressure to the bleeding point. An elastic bandage should be applied to permit walking Later operative treatment should be carried out.

Phlebitis of Varicose Veins. This complication causes much pain and tenderness but carries none of the disabilities and dangers of deep phlebitis The treatment is to apply an elastic adhesive bandage from the foot to a point well above the affected part. The bandage should be applied firmly to compress the veins until organisation has occurred Pain is severe while the bandage is being applied, but is completely relieved within a few hours, and often the patient is then able to resume normal activity

PHLEBITIS AND THROMBOPHLEBITIS

This condition is seen most often as a post-operative complication though it can occur spontaneously in old people or after a severe illness It generally affects the deep veins of the calf or thigh, or veins in the pelvis. In some cases clotting occurs within normal veins (phlebothrombosis) and then there are few symptoms or none at all and since the clot lies almost free in the lumen it may break off and be carried to the lungs (pulmonary embolism, p 358) In other cases the clotting occurs within veins which are inflamed (thrombophlebitis) and then symptoms are usually present but since the clot is firmly anchored the risk of embolism is not great.

The condition may develop immediately after operation but more often it is not noted until a few days or a week or so later It may indeed be overlooked until the occurrence of pulmonary embolism brings it urgently to notice. Pain in the calf is usually the first symptom. There is tenderness on deep pressure over a localised area in the calf muscles. Pain in the calf can sometimes be elicited by forcible dorsiflexion of the foot (Homan's sign) There is slight œdema at the ankle In more severe cases (seen formerly after childbirth) the whole limb is tense, shiny white and painful (*phlegmasia alba dolens*)

Stagnation of blood during and after operation is regarded as the main cause, and active movement in the immediate post-operative phase is the most important method of prevention.

The treatment is by anticoagulants which are rapidly effective in arresting the thrombosis, and moreover promote absorption of the clot already formed. At the first suspicion of phlebitis 150 mg (15 000 units) of heparin is injected intravenously followed by 100 mg three or

four times daily for several days and once daily for a few days thereafter *The limb is not immobilised but, on the contrary, moved freely from the first.* As soon as the temperature settles the patient is allowed up with a supporting bandage to prevent oedema

Heparin is almost free from danger and can be used without repeated blood checks It should be avoided, however in the presence of an operation wound or a recent fracture Its effects can be countered within a few minutes by 10 ml of 1 per cent. protamine sulphate intravenously

For prolonged anti-coagulant treatment ethyl biscoum acetate or Tromexan is used, in dosage of 0·6 gram twice daily for two days and thereafter 0 3 gram twice daily The prothrombin level must be estimated daily and the dose varied accordingly Its effect may be countered by intravenous vitamin K or by blood transfusion

Primary thrombosis of the axillary vein and rarely of other veins may occur There is generally a history of previous trauma or an occupational strain. The thrombosis occurs suddenly and causes *swelling* cyanosis and coldness of the arm. It is to be diagnosed from an embolism of the axillary artery (p 87) The treatment is to maintain the arm at rest and elevated and give anticoagulants.

AIR EMBOLISM

This rare accident occurs when a large vein injured during operation is held open by scar tissue so that air is sucked in It occurs most commonly in deep operation wounds in the lower part of the neck or in the axilla or thorax The air is drawn into the right auricle and interferes with the heart s action by frothing

The condition can be recognised by a hissing sound in the depths of the wound during inspiration and by the escape of frothy blood during expiration. Respiration becomes laboured the pulse becomes weak and rapid and the pupils dilate. On auscultation a loud churning sound is audible. Death may occur within a few minutes if a large quantity of air gains entrance rapidly In most cases there is rapid recovery

Air embolism should be prevented by care during operation. Usually its effects are temporary but in severe cases cardiac massage may be necessary

FAT EMBOLISM

This rare condition occurs mainly as a complication of fractures, and is thought to result from the entry of globules of the marrow fat into the circulation The globules are carried to the lungs, and some may then enter the systemic circulation and reach the cerebral vessels.

The clinical features are referable to pulmonary or cerebral embolism. They may appear a few hours after the fracture or three or four days later The temperature and pulse rate are increased, cyanosis and dyspnoea may develop and there may be pain in the precordial region whilst auscultation reveals the presence of moist râles in all parts of the chest.

Cerebral fat embolism leads to restlessness excitement and delirium later progressing to coma. The clinical features may resemble delirium tremens very closely

In some cases embolism of the skin vessels leads to the development of multiple cutaneous petechiae. Fat globules may appear in the urine.

Often the condition is fatal. Death may occur within forty-eight hours or be delayed for several days There is no effective treatment.

CHAPTER 10

THE LYMPH GLANDS AND VESSELS

Injuries to Lymph Vessels

INJURIES to small lymph vessels form an inevitable part of any open wound, but they generally pass unnoticed and cause no ill-effects Exceptionally if the proximal channels are blocked by previous inflammation or malignant permeation a fistula results, and pours out considerable quantities of clear lymph In most cases however such a fistula closes spontaneously

Injuries to the Thoracic Duct. The thoracic duct is most liable to injury in the course of operations at the root of the left side of the neck. The injury may be recognised at the time by the escape of milky fluid into the wound The duct should in such cases be dissected free and ligated for the collateral channels suffice to direct the fluid into the venous system by other routes

If the injury is not recognised at the time, chylous fluid may collect in the wound, or a chylous fistula may result. Generally such a fistula closes within a few days but occasionally it persists and may bring about a state of inanition or even death through loss of the nutritive chyme. The treatment is to pack the fistula tightly with sterile gauze, so as to encourage the establishment of a collateral circulation

Chylothorax. This signifies a collection of chylous fluid in the pleural cavity It may follow damage to the thoracic duct from a crush injury of the thorax, or it may arise spontaneously especially if the duct is obstructed by malignant disease. The diagnosis is made on microscopic examination by the demonstration of fat globules in a fine state of division. Chylothorax is treated by repeated aspiration of the fluid

Chyloperitoneum (Chylous Ascites) This is a similar condition in which the milky fluid escapes from the lower part of the thoracic duct or from the receptaculum chyli into the peritoneal cavity It is treated by repeated aspiration of the fluid.

Lymphatic Œdema Elephantiasis

This term is applied to severe forms of œdema due to blockage of lymphatics. The condition may follow neoplastic invasion of lymphatics (e.g œdema of the arm in cancer of the breast) or surgical removal of lymph tracts (e.g groin clearance for carcinoma of the scrotum) or infection of lymphatics (e.g filarial elephantiasis see below) Finally it may occur as a primary idiopathic or spontaneous affection.

This latter type occurs most often in women and is usually unilateral It is probably due to congenital aplasia or obstruction of lymphatics at the groin. The œdema may be present at birth (Milroy's disease) or appear in adolescence or early adult life.

The limb is greatly swollen, the skin coarse and corrugated the superficial tissues thickened, tough and fibrous. In striking contrast the muscles and indeed all structures deep to the fascia lata are quite normal (by reason of their independent lymph drainings alongside the femoral vessels.

Despite the ugly appearance there are few symptoms, but the size

and weight of the limb cause some disability In mild cases it suffices to apply elastic bandages and to elevate the foot of the bed. In more severe cases, many types of operation have been described. The most successful though radical, is to flay the limb (from below the knee to the foot) removing in one piece the whole thickness of skin, fat and deep fascia. With a dermatome a large split skin graft is removed from the excised specimen and reapplied as a free graft.



FIG. 50 Congenital elephantiasis in a woman aged 25.

Filarial Elephantiasis. This condition arises in persons infected with the *Filaria sanguinis hominis* and is due to lymphangitis caused by the irritation of parasites present in the lymph vessels. It is common in tropical Africa It generally affects the genital region especially the scrotum which may become enormous. The testes on account of their different lymph drainage and the body of the penis are unaffected. The treatment is to excise the scrotum a formidable operation in such cases. The testes are preserved and implanted under the skin of the thighs retaining their connections The penis, denuded of its thickened skin may be covered with split skin grafts

Acute Lymphangitis and Lymphadenitis

The lymph vessels and glands may be inflamed as a result of any acute infective process in their catchment area. *Streptococcal infections* of the fingers and hand are the commonest cause (p 160)

Lymphangitis is indicated by extreme tenderness and a scarlet flush

along the line of the lymph vessels, which may be palpable as delicate cords lying in the subcutaneous tissue.

Lymphadenitis is indicated by palpable enlargement and tenderness of the glands. In severe cases the onset is often acute, and is marked by malaise, pyrexia, and sometimes rigors and severe toxæmia.

The affected part may be kept warm by means of cotton wool or may be placed under a heat cage. The primary focus must receive appropriate treatment. Penicillin is given, supplemented by other antibiotics. If suppuration develops the abscess must be opened

Tuberculous Lymphadenitis

The *rôle* of the lymph glands in the early stages of tuberculous infection has already been considered (p 20) It will be remembered that in the majority of cases the tubercle bacilli, immediately after gaining access to the body, are carried to the lymph glands nearest to their point of entry, and there give rise to the formation of tuberculous follicles The disease may remain limited to this one group of glands if it is of mild virulence and the general resistance is sufficiently high, or it may spread to other lymph glands, and subsequently to other tissues and organs.

From the surgical standpoint, the important sites for glandular tuberculosis are the neck and the abdomen. The special features of the disease in these situations are considered in the regional chapters.

Lymphadenoma (Hodgkin's Disease)

This disease affects young adults, and is characterised by changes in the lymph glands and sometimes in the spleen, liver and blood.

The ætiology is not understood The disease has been thought to be due to a low grade infection perhaps tuberculosis, to be related to blood diseases such as leukæmia or to be due to a virus.



FIG. 51 Lymphadenoma (Hodgkin's disease) in a man aged 35. The glands had been present for three years and had recently enlarged rapidly They were of firm consistency and freely mobile. Glands were also present in the axilla. There was considerable anæmia and asthenia.

Glandular enlargement is usually the first sign of the disease. At first there is enlargement of a single group of glands, most often in the neck, but sometimes in the axilla, the groin or elsewhere. Later the disease spreads from region to region, and eventually may involve nearly all the glands in the body

The affected glands are greatly enlarged, soft, fleshy, and of an elastic consistence. They do not undergo caseation or softening and no cold abscess forms. There is no peri adenitis, and consequently the glands remain discrete and freely mobile even when large. They never become calcified. In all these features they differ from tuberculous glands

Microscopically the glands show proliferation of endothelial cells and lymphocytes, and often there are giant cells resembling the mega karyocytes of the bone marrow In the later stages the glands become extensively fibrous.

The spleen is enlarged in most cases, and it may contain white nodules sometimes large and suet like, which microscopically present the same characters as the lymph glands. The liver may be similarly involved. Rarely ulcerative lesions develop in the wall of the stomach and small intestine.

The blood picture is that of a secondary anæmia, with leucopenia and sometimes eosinophilia.

Clinical Course. The course of Hodgkin s disease is very variable. Sometimes it is rapidly progressive and it may be fatal within a year but much more often it takes a chronic form, and its progress may be arrested for many months or even years.

The symptoms in chronic cases are not marked. The general health is but little impaired, and the main feature is weakness, with fatigue on slight exertion. In more acute cases the general impairment of health is more marked, and there are periodic attacks of increased malaise with marked weakness. During the attacks the temperature is elevated for several days, perhaps to 101° F These "Pel Ebstein " phases may recur every few weeks.

Diagnosis. The glandular swellings must be diagnosed from tuberculous glands. Generally this is not difficult, for the mobile, discrete, elastic swellings of Hodgkin s disease are quite unlike the adherent, often caseous glands seen typically in tuberculosis. There are, however, occasional cases where, on clinical examination, there remains some doubt. In these radiographic examination may be carried out, for many old tuberculous glands are partly calcified To clinch the diagnosis a gland should be removed under local anæsthesia and examined microscopically

Hodgkin s disease may also have to be diagnosed from leukæmia and from syphilitic adenitis. The blood picture and the Wassermann reaction generally make the distinction clear

Treatment. The treatment is to apply deep X ray therapy to the glands and the spleen. Arsenic should be given in full doses. In some cases Nitrogen Mustard 0 1 mg per kilo has proved effective. Despite

all treatment, however, the disease tends to spread and ultimately is nearly always fatal

Lymphogranuloma Inguinale

This virus infection is seen most often in tropical and Mediterranean countries but occasionally arises in Great Britain as a result of infection by persons returning from abroad. Infection is usually sustained during sexual connection A small ulcer develops on the glans penis or on the cervix uteri and from thence the infection spreads to the inguinal glands which enlarge and later become matted together forming an adherent tender mass Later an abscess forms.

Lymphogranuloma inguinale is also apt to cause elephantiasis of the vulva (Esthiomène) and stricture of the rectum

The diagnosis is confirmed by Frei's test, which consists of an intradermal injection of pus (suitably sterilised) from a lymphogranuloma inguinale abscess. A positive reaction is indicated by a papule with surrounding erythema, appearing in forty-eight hours and persisting for several days

The treatment is to give antibiotics.

Tumours of Lymphoid Tissue

Lymphangioma. A lymphangioma is a simple tumour closely similar in structure to a hæmangioma (p 80) It is usually congenital in origin The following three types are described:—

Capillary Lymphangioma This tumour closely resembles a capillary hæmangioma. It occurs most commonly under the mucous membrane of the tongue or cheek or may lie subcutaneously in any part of the body It forms an ill-circumscribed, slightly raised swelling often nodular on the surface and yellowish in colour It may be excised or treated by CO_2 snow or by irradiation.

Cavernous Lymphangioma. This is thought to arise from the confluence and dilatation of the lymph spaces of a capillary lymphangioma. It arises most often in the submucous or subcutaneous tissues, and forms a soft swelling somewhat ill-defined which may be mistaken for a lipoma. It may be treated by excision or electrolysis

Cystic Lymphangioma (Lymphatic Cyst; Cystic Hygroma) This is thought to arise from cystic dilatation of a cavernous lymphangioma. It is generally congenital, and is found most often under the deep fascia of the neck, either in front of or behind the sterno-mastoid muscle. The cyst may attain large size and extend in various directions between the muscles Its wall is thin and adherent to adjoining structures

Less often a hygroma occurs in the axilla, under the tongue or in the groin. The cyst may persist for years but often disappears spontaneously It is liable to attacks of inflammation, and an attack may effect a cure.

A small cyst may be excised A large one should not be operated upon for it is often very adherent and extensive. It should be tapped and injected with a few cubic centimetres of a sclerosing solution such as sodium morrhuate.

Reticulo-sarcoma; The term reticulo-sarcoma is now used to describe a variety of malignant tumours arising from the cells of the reticulo-endothelium system or their primitive mesenchymal ancestors. It includes the majority of soft-tissue sarcomata arising from the skin, fasciæ, muscles and lymph glands and also Ewing's tumour of bone, multiple myeloma and atypical varieties of Hodgkin's disease, all of which are characterised by rapid growth, high malignancy and a dramatic but transient response to radiotherapy

Lymphosarcoma is a special member of this group which may arise in lymph glands in any part of the body or in lymphoid tissue such as the

Peyer s patches of the ileum Its most common site of origin is in one of the lymph glands of the neck, axilla or groin

The tumour increases in size rapidly involves adjoining structures, and may ulcerate. Other glands in the vicinity are soon involved.

The diagnosis must be made from a syphilitic gumma a metastatic tumour and leukæmia.

Surgical treatment is rarely possible, and reliance is placed on radiotherapy Usually under this treatment the tumour diminishes rapidly and may disappear in a few weeks but almost invariably recurs and metastasises

CHAPTER 14

AFFECTIONS OF BONES

ACUTE OSTEOMYELITIS

Pathological Features. Acute osteomyelitis is an acute suppurative infection of bone It is generally caused by *Staphylococcus aureus* which reaches the bones *via* the blood stream from a distant focus, often a trivial skin or throat infection A blood infection (bacteræmia) is generally present during the first few days.

The disease generally affects the upper end of tibia or lower end of femur but no bone is exempt. It starts in the metaphysis, the actively growing part of the bone immediately on the shaft side of the epiphysial cartilage. Often a minor injury to the bone predisposes it to infection probably by causing a minute hæmorrhage, a favourable nidus for organisms.

The infection calls forth an intense reaction, with pus formation in the narrow spaces From there the suppuration spreads along the marrow cavity and also through the cortex, to erupt on the surface and form a subperiosteal abscess. If untreated part of the bone becomes necrotic, owing to the toxic effect of pus under tension The main nutrient artery may be thrombosed, leading to necrosis of the major part of the diaphysis.

Clinical Features. Acute osteomyelitis generally affects children especially if in poor health, as after an infectious fever In a typical case the onset is sudden and may be marked by a rigor Then pain and inflammation of the bone follow accompanied by marked toxæmia. The temperature rises, often to 103° or 104° F The leucocyte count rises to 15 000 or more. Localising signs develop early in the case of a superficial bone such as the tibia, later if the bone is deeply placed.

In atypical cases the intensity of the toxæmia may quite overshadow the local lesion and this may remain unnoticed. In mild cases, on the other hand, there may be comparatively little toxæmia, while the main local sign is the development of a superficial abscess.

Treatment. The use of penicillin has revolutionised the treatment of what was formerly often a fatal and always crippling disease. Penicillin should be given promptly in every suspected case, for delay may involve necrosis of the bone and prolong the infection. It may need to be continued If the organism is penicillin resistant, other antibiotics must be tried Where a completely resistant organism is present there is no specific treatment available.

Opinions vary as to the surgical treatment. Some prefer to wait until there is definite evidence of an abscess, and then to carry out a simple incision. Most surgeons, however think it wise to operate early The incision is made over the point of maximum tenderness and

the sub-periosteal abscess opened After all pus has been evacuated th incision is closed Subsequently the limb is immobilised in an elevate position.

CHRONIC OSTEOMYELITIS

In untreated cases acute osteomyelitis may persist as a chronic infectio flaring up at intervals over many years, with recurrent abscess and sinu formation. In some such cases X-ray examination reveals a cavity in the bon which may contain a portion of dead bone or *sequestrum* In others the bon is irregularly sclerotic over a wide extent.

If a sequestrum is present it should be removed. The cavity should b opened widely by chiselling away its bony roof Sometimes it is possible t fill the cavity by turning down a flap of muscle. A split skin graft or pedic graft may be needed to cover the area. Penicillin is only effective in acu exacerbations

DYSTROPHIES OF BONE

Congenital Fragility of Bone

This is a hereditary disease, transmitted directly from parent t child as a Mendelian dominant. It is generally associated with othe inherited characteristics, blueness of the sclera, a tendency to double jointedness, and a tendency to deafness from otosclerosis. In sever examples multiple fractures occur *in utero* during birth or in earl infancy More often the disease shows itself in childhood and th number of fractures does not exceed six or eight. When the patien reaches adult life the tendency to fractures generally diminishes.

The only treatment is to protect from injuries as far as possible When a fracture occurs it is treated on general lines. Union is sometime delayed, but in most cases is eventually complete. In some cases the bones become quite strong at puberty and just before that time it is advisable to correct any established deformities by operation.

Osteochondritis Juvenilis

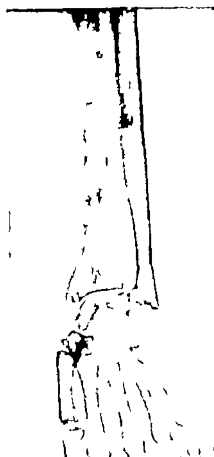
This term includes a variety of lesions, the more common of which are Legg-Calvé-Perthes disease of the head of femur Osgood-Schlatter disease of the tibial tuberosity Sever s disease of the calcaneus, *Köhler s* disease of the tarsal navicular and Scheuermann s disease of the vertebræ.

These various lesions are similar in pathology and clinical features. They affect the epiphyseal regions, especially in boys, and occur at characteristic age periods, varying with the particular epiphysis involved. The affected part of the bone becomes altered in structure by the formation of areas of sclerosed bone with intervening zones of osteoporosis, so that the epiphysis undergoes a characteristic frag mentation which is readily seen on radiography

The clinical features and treatment of the individual lesions will be dealt with in the regional chapters.



Post traumatic osteoporosis.



Osteitis fibrosa due to a parathyroid tumour



Paget's disease (osteitis deformans). Note the [illegible]

Post-Traumatic Osteoporosis

This affection follows an injury such as a fracture or strain, or even a severe contusion It is important as a cause of continued disability after comparatively small accidents.

Most often it affects the small bones of the foot or hand The symptoms may come on shortly after the injury, or several weeks or even months later There is pain which is disabling and persistent, and accompanied by stiffness of the joints Vasomotor changes occur, the part is oedematous, cold and pallid, the skin is glossy and perspires easily Radiography shows irregular decalcification of the articular ends of the affected bones, and in severe cases their outlines are blurred or almost completely obscured The shafts of the bones are but little affected (Plate III, p 104) Later recalcification sets in and the condition may be restored to normal, or arthritic changes may develop

The condition is to be distinguished from tuberculosis and from rheumatoid arthritis The diagnosis is based upon consideration of the clinical features and the characteristic radiograms.

Treatment. In mild cases the use of diathermy and radiant heat may give relief In more severe examples the affected part should be immobilised completely in a plaster case for three months. Later gentle manipulation may be required to increase the range of movement. It has been claimed that in some cases relief of pain may be secured by sympathetic ganglionectomy

Osteitis Fibrosa

In this disease the bones become decalcified, the trabeculæ and lamellæ reduced in size and the intervening bone spaces filled with vascular connective tissue. Ultimately all the bones of the skeleton may become so soft that they can be cut like leather with a knife In some cases multiple cysts develop in the bones

The disease is due nearly always to the action of an adenoma of one of the parathyroid glands, which produces an excess of the para thyroid secretion parathormone. The effect of this is to liberate calcium phosphate from the skeleton and thus to give rise to the characteristic bone softening The freed calcium, passing into the blood stream, " overflows " through the kidneys and is excreted in the urine. Not infrequently it crystallises out from the urine giving rise to renal calculi, often massive and bilateral.

Osteitis fibrosa occurs mainly in young adults, especially women It runs a progressive course and, if untreated, ends fatally within a few years

Clinical Features In the early stages the general health is impaired and the patient complains of weakness and of vague pains in the limbs. Sometimes a pathological fracture is the first sign Then deformities of the bones develop The tibia and femur become bowed antero-laterally the spine becomes kyphotic. Finally anæmia and cachexia lead to death. In some cases the discovery of bilateral renal stones draws

attention to the disease, while the consequent renal damage may contribute to the fatal issue.

Diagnosis Generalised osteitis fibrosa is to be diagnosed from other causes of bone softening, especially (1) osteomalacia (2) multiple myeloma (3) multiple carcinomatous metastases Radiography shows the affected bones somewhat broadened and *diffusely decalcified* (Plate III, facing p 104) The diagnosis is confirmed by biochemical findings (p 818)

Treatment. (1) The patient should be placed in absolute recumbency to avoid putting any strain on the softened bones.

(2) The parathyroid glands should be exposed by operation and an adenoma sought and removed.

In a few cases on record no tumour has been found, but nevertheless operation is always advisable once the diagnosis has been established, as indicated above The incision is like that for removal of the thyroid gland. It must be remembered that the parathyroid glands vary greatly in situation, and the tumour may be as high as the base of the skull or as low as the mediastinum. If, therefore, no adenoma is found on careful search of the neck, it is necessary to split the sternum in order to inspect the anterior mediastinum.

(3) Subsequently calcium must be administered in large doses to hasten recalcification.

(4) Renal calculi may demand appropriate treatment.

Prognosis While successful operation arrests the progress of the disease, recovery takes place very slowly, and in severe cases complete return to normal cannot be expected.

Cysts in Bone

The following types of cyst occur in bone: (1) cysts with osteitis fibrosa (see above), (2) cysts with giant cell tumours (p 109) (3) hydatid cysts which clinically resemble those with osteitis fibrosa and (4) simple cysts.

A simple cyst nearly always originates at the upper metaphysis of the humerus and is commonest in boys aged 10 to 15 years. It enlarges insidiously and painlessly and its bony wall may be reduced to a thin shell. Pathological fracture is common and is usually the first evidence of the cyst. Radiography (Plate IV facing p 108) reveals an ovoid well-defined defect surrounded by a thin shell of normal bone.

Treatment If unfractured, expose the bone open the cyst, curette its lining membrane and close the wound. Protect the bone from injury until healed. If fractured treat as an ordinary fracture. Union though sometimes delayed, occurs and generally obliterates the cyst.

Osteitis Deformans (Paget's Disease)

This disease, not uncommon, occurs in elderly people. It generally affects the whole skeleton The bones pass through a brief stage of softening during which they tend to become bent and deformed, and then become thickened and sclerosed by new ossification. The illustration (Paget s own case) shows the typical appearance, and the condition is readily recognisable. Radiography shows diffuse irregular sclerosis of the bones (Plate III facing p 104) Clinically Paget s disease is impor



Fig. 52 Osteitis deformans (after Paget).

tant (1) as a cause of vague pains in the bones and deformities developing in elderly people (2) as predisposing to fractures, and (3) as leading sometimes to the development of bone sarcoma. The cause is not known and there is no treatment.

TUMOURS OF BONE

Ivory Osteoma

This tumour nearly always arises from the membrane bones of the skull, especially from the outer table. It grows very slowly and forms an ivory hard mass which may cause symptoms by pressure on adjoining structures.

The diagnosis is evident by the dense sclerosed nature of the tumour as seen in a radiograph.

If treatment is required the tumour may be removed by drilling and chiselling—sometimes difficult owing to the dense character of the bone. Often, however the tumour grows so slowly that no treatment is called for

Osteochondroma

This tumour generally arises from the metaphysis of a long bone, especially just above or below the knee. It originates as a developmental displacement of part of the epiphyseal cartilage on to the surface of the bone. Ossification in this displaced cartilage continues during the whole period of skeletal growth.

The tumour arises in childhood, but may remain unnoticed for a

long time It forms an obliquely placed spur or pedunculated mass of bone, capped by a mass of cartilage, which becomes calcified at the age of 20 to 25 years In some cases the tumour is large and sessile, with a massive cartilaginous cap

An osteochondroma is often symptomless, but it may cause disability by pressing on a nerve or impeding the movement of a joint. An adventitious bursa may form over it and become inflamed

Treatment consists in removing the tumour taking care to excise the whole cartilaginous cap

In *diaphysial aclasis* there are multiple osteochondromata (multiple exostoses) affecting many bones. The treatment is to remove any tumour causing disability

Chondroma

Multiple chondromata arise in the metacarpals and phalanges (rarely in the corresponding bones of the foot) and form globular tumours, at first lying within the bones (enchondroma) later projecting under the periosteum (ecchondroma) The tumours enlarge slowly at first and may cease to grow or even diminish in size. They are lobulated, smooth, rounded and of elastic consistence, though eventually they may acquire a thin bony shell. They may cause much disability by deforming the fingers and impeding movement.



Fig. 53 Multiple chondromata of the hand.

The treatment is conservative as far as possible. Tumours of this type are always benign They may be removed entire, if possible cleanly or failing this, by curettage.

Solitary chondroma is uncommon. It occurs in the long bones, the spine, pelvis or thoracic cage, forming a lobulated mass of firm elastic consistency Sarcomatous change is common.

The treatment is to excise the tumour if practicable.

Giant Cell Tumour
Osteoclastoma

This tumour which is nearly always benign, is composed of soft, solid pinkish-grey tissue, which often contains cysts filled with blood stained fluid Micro-



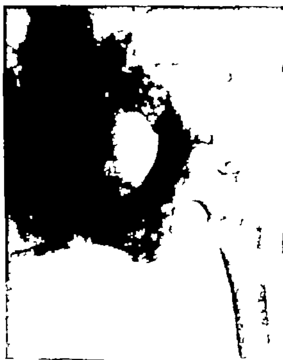
Giant-cell tumour of tibia: radiograph of a specimen.



Sarcoma of tibia.



Osteogenic sarcoma of periosteal type showing bony spiculation and sub-periosteal wedge of new bone



Multiple metastases in bones, secondary to carcinoma of the breast.

[To face p. 108.

PLATE V



Cyst of humerus, showing a pathological fracture which has united



Ewing s tumour of calcaneus.



Metastases in spine and pelvis from carcinoma of prostate. Note the mottled sclerosis of the bones.



Metastasis in hymerus, from a hyper nephroma of the kidney

scopically it is characterised by the presence of multinucleated giant cells similar to osteoclasts.

The tumour may affect any bone but is found most commonly in the epiphysis at the lower end of the femur or the upper end of the tibia. Originating in the substance of the bone, it enlarges gradually, forming a globular mass which may attain considerable size. In enlarging it excavates and "expands" the bone which is eventually reduced to a thin shell.

Clinical Features. *The tumour occurs most often between the ages of 15 and 40 years.* Pain may be a prominent feature, but is variable. Often the first evidence of the disease is produced by a "pathological" fracture or by instability of the related joint. On examination, if the bone is superficially placed, the globular shape of the tumour may be evident. Egg-shell crackling may be elicited if the bony capsule is sufficiently thin.

Radiography shows a translucent area surrounded by a bony shell which may be expanded. Often a honeycomb appearance is seen, owing to the presence of bony trabeculæ within the tumour. The outline of the growth is well defined and clearly circumscribed (Plate IV, p. 108).

Diagnosis. The tumour is to be distinguished from a bone cyst or a simple chondroma. If doubt remains after radiography, biopsy may be required.

Treatment. In view of the benign character of the tumour in most cases, conservative surgery is generally indicated. If practicable the tumour should be exposed and removed from its bony cavity by curettage, residual tumour tissue being destroyed by irradiation. If such a procedure is likely to weaken the bone unduly, it may be more practicable to resect the affected segment and replace it by a bone-graft. Sometimes, e.g. in the case of a massive tumour at the lower end of the tibia, amputation may give the best functional result.

Bone Sarcoma (Osteogenic Sarcoma)

This highly malignant growth is generally of the small spindle cell variety. It grows rapidly, invading the bone and soft tissues, and almost invariably metastasises to the lungs and other tissues. In over 90 per cent. of cases death occurs within a year or two, even despite early radical amputation. As a rule the growth arises close under the periosteum and spreads both within the bone and under the elevated periosteum. It invades the muscles at an early stage, but does not involve the skin until late. The related joint may be distended with watery fluid, but is not involved by the growth.

Bone sarcoma arises most often at the metaphysis of a long bone, especially just above or just below the knee. It is rare in the distal parts of the extremities, but no bone is exempt. The growth causes decalcification and destruction of the invaded bone, while in most cases some new bone is laid down in other parts of the tumour, especially under the elevated periosteum, in the form of delicate "sun-ray

spicules (Plate IV, facing p 108) Thus a bone sarcoma generally combines osteolytic and osteogenetic activities, the relative degree varying with the vascularity of the tumour In young subjects a very actively growing sarcoma may be entirely osteolytic and form a soft growth, which may be so vascular that it pulsates. On the other hand the tumour may be extensively ossified (*sclerosing sarcoma*)

Clinical Features. Not infrequently there is a history of a recent local injury The first symptom in most cases is pain, which is worse at night, and may by its severity hasten cachexia. Pathological fracture is common If the bone is superficial, a palpable lump appears early It is quite painless, ill-defined at first, and soon adherent to the muscles. Its consistency varies greatly, and it may be soft and highly vascular or of bony hardness. As the tumour enlarges, dilated veins appear and the skin becomes tense and shiny, and may even ulcerate

The X ray shows irregular mottled erosion and resorption of the bone. New bony spicules of " sun ray " type may be present under the elevated periosteum, while in some cases a wedge of new bone is found at the point of periosteal elevation farthest from the tumour

In doubtful cases biopsy may be necessary to establish the diagnosis.

Treatment. If practicable the limb should be amputated at a high level. Pre-operative irradiation of the tumour has been advised as also has post-operative irradiation of the lungs

Chondrosarcoma may occur either *de novo* or as a complication of chondroma (p 107) It is not amenable to radiotherapy and should be excised if possible.

Fibrosarcoma may arise from the periosteum and be mistaken for a bone sarcoma. It is much less malignant and should be excised if possible.

Ewing's tumour is now regarded as a special type of reticulo-sarcoma (p 101) It generally occurs in young subjects, especially from 5 to 15 years of age, and grows rapidly metastasising early to the regional glands and to other bones and viscera.

Clinically it gives rise to pain often intermittent, in attacks of increasing severity Radiography shows diffuse osteoporosis (Plate V, p. 109) sometimes with layers of new bone laid down under the periosteum. The condition is to be diagnosed from chronic osteomyelitis which it may resemble closely and from a metastasis secondary to a tumour of the bronchus or adrenal gland. Biopsy may be required. Irradiation therapy brings about rapid but temporary improvement. Following irradiation, amputation should be performed.

Multiple Myelomata

This is a disease of the bone marrow characterised by the growth of multiple tumours, which may involve nearly the whole skeleton The tumours are generally recognised first in the ribs, cranium and other superficial bones. Most of the tumours are of small size, but one or more may grow more rapidly The condition often gives rise to the presence of " Bence-Jones proteose " in the urine, manifest as a faint opacity which forms on heating the urine to 55° C. and disappears on further heating X ray examination shows the presence of multiple clear-cut defects in the bones.

Multiple myelomata are to be diagnosed from (1) multiple

carcinomatous metastases (2) osteitis fibrosa with multiple tumours The diagnosis can be made most readily by marrow puncture. There is no treatment.

Skeletal Lipoid Granulomatosis
(*Xanthomatosis of Bone*)

This disease mainly seen in children is characterised by the development of multiple tumours chiefly in the cranial bones and the mandible. The tumours are of xanthomatous type and consist mainly of large phagocytic cells containing cholesterol globules It is thought that the condition is essentially due to a disturbance of cholesterol metabolism and that the tumours " are merely collections of phagocytic cells engaged in disposing of excess of the lipoid Frequently pressure by the tumours gives rise to exophthalmos (orbital tumour) diabetes insipidus (tumour pressing on pituitary stalk region) and swelling of the gums (tumour of mandible) Loosening of the teeth may be the first sign. Radiography is of value it shows large rounded well-defined defects in the affected bones. Biopsy confirms the diagnosis.

X-ray therapy should be applied It generally leads to arrest of the disease.

Secondary Tumours in Bone

Bone may be involved in secondary tumours (1) by direct invasion from an adjoining carcinoma (2) by blood borne metastases.

Metastases in bones most commonly follow carcinoma of the breast and prostate, less often tumours of the lung kidney or thyroid gland, rarely other growths. They are found most often in the sites where red marrow is commonly present, namely the vertebræ, pelvic bones, neck of femur upper end of humerus, ribs and sternum. The metastases are generally multiple, and in most cases (though not in prostatic carcinoma) form osteolytic lesions which lead to patchy destruction of the bone (Plates IV and V facing pp 108 and 109) In this way they predispose to a pathological fracture. Their special features are con sidered in the appropriate sections.

FRACTURES

In this section the general features of the causation diagnosis and treatment of fractures are considered. Individual fractures are dealt with in the regional chapters.

A fracture may result from (1) direct violence (2) indirect violence or (3) muscular action When due to direct violence, the fracture occurs at the point of impact, and is generally transverse and often com minuted. When due to indirect violence, the fracture is situated at a distance from the point of impact, and is usually oblique or spiral A fracture due to muscular action is seen most often in the patella, which is snapped across the femoral condyles by a sudden contraction of the quadriceps.

Varieties of Fracture. *A simple or closed fracture* is one in which the skin is intact, or more accurately one with no communication through skin or mucous membrane to the exterior

A compound fracture is one communicating with the exterior through a wound of the skin or of a mucous membrane. The wound may be caused by the impact of the fracturing force, and foreign matter is apt to be forced into the wound with grave risk of sepsis; or it may be caused from within by a pointed spicule of bone, when the risk of contamination is less.

A comminuted fracture is one in which the bone is broken in more than one place It generally results from direct violence. In most cases there are one or more small fragments between the ends of the two major portions of the bone.

A complicated fracture is one complicated by injury to a vessel, nerve, joint or viscus.

A greenstick or subperiosteal fracture is one in which the soft bone of a child cracks and bends, but the thick periosteum remains intact and holds the fragments together

An impacted fracture is one in which the end of one fragment is driven into the cancellous bone of the other

A pathological or spontaneous fracture is one affecting an abnormally brittle bone or a bone softened by disease or malignant infiltration. It may result from an apparently trivial injury or even from muscular pull or the action of gravity

Displacement of the Fragments. Except in greenstick fractures, some displacement of the bone ends is the rule. The displacement may result from any of three causes (1) the action of the fracturing force (2) muscular contraction (3) gravity These three factors are seen typically in a fracture of the shaft of the femur when the lower fragment is displaced to one side by the fracturing force, drawn proximally by the long muscles of the thigh, and rotated laterally by the weight of the foot.

The Process of Union in Fractures. Several distinct stages may be seen in the normal process of union of a fracture —

Formation of a Hæmatoma. The blood effused from the bones and from the lacerated periosteum and muscles collects between and around the bone ends and forms a hæmatoma.

Organisation of the Hæmatoma. Within twenty four hours of the injury young fibroblasts and capillary loops grow from the surrounding tissues into the blood clot, and in a week or so it becomes organised as granulation tissue.

Formation of Callus The bone ends close to the fracture become decalcified and the soluble calcium thus liberated is carried into the granulation tissue of the hæmatoma and there deposited. This calcified tissue is known as callus. Normally callus becomes demonstrable radiologically about the third week. The callus forms a fusiform mass between and around the bone ends, and according to its situation is divided into internal callus (opposite the marrow cavity) intermediate callus (between the cortical zones of the two fragments) and external callus (*surrounding the site of fracture*)

Ossification of the Callus The calcified fibrous tissue of the callus is

converted into true bone by specialised connective tissue cells known as osteoblasts. At first the new bone forms a fusiform mass, like a plumber's joint. Then it becomes consolidated and the excess is absorbed. If the bones are not in perfect apposition the projecting margins are also absorbed and following Wolff's law, new lamellæ are laid down along the altered lines of stress.

Clinical Features of Fractures A typical case presents the following clinical features. It must be emphasised, however that any or all of them may be absent, and that in suspected cases radiography should be insisted upon.

(1) There is usually a history of an injury and often the patient feels the bone snap

(2) There is generally some loss of function varying from pain on movement to complete loss of power

(3) The part may be swollen and in a few days may show bruising as the effused blood gravitates along the tissue planes towards the surface, sometimes at a distance from the site of fracture.

(4) There may be visible angulation at the site of fracture.

(5) The bony points may be altered in position, or the limb may be shortened.

(6) There is tenderness on pressure over the fracture, and generally there is pain on moving the limb

(7) There may be abnormal mobility at the site of fracture.

(8) Crepitus may be elicited, unless the fragments are impacted or separated by soft tissues.

Radiographic Examination. This examination must be carried out in every suspected case of fracture. Failure to advise it constitutes negligence and renders the practitioner liable to an action for damages

Radiography should generally be carried out when the case is first seen, and should be repeated after reduction of the fracture and at intervals during healing Radiographs should be taken in two planes, at right angles, for otherwise the degree of displacement cannot properly be assessed, and a small crack may be missed.

Complications. Apart from lesions caused by the bone fragments, such as an injury to a vessel, nerve, joint or viscus, the following complications may arise:—

(1) *Shock* is marked in certain fractures, e.g fracture of the pelvis or of the shaft of femur In elderly persons even a small fracture may cause much shock.

(2) *Fat embolism* is very rare and results from the entry of globules from the marrow fat into the circulation. The globules are carried through the lungs into the systemic circulation, and some thus reach the cerebral vessels, giving rise to delirium, and in severe cases coma and death (p 96)

(3) The *general disturbance* incident to the fracture may precipitate cardiac failure, pneumonia, delirium tremens and other illnesses where a predisposition exists.

(4) Various complications follow specific fractures, e.g Volkmann's

contracture in fractures in the elbow region. They are described in the regional chapters.

Treatment of Simple Fractures

First-Aid Measures The objects in the emergency treatment of fractures are to relieve pain, to prevent further displacement of the fragments during transport to hospital, and to prevent damage to the soft tissues by the sharp bone ends. In serious cases first aid treatment for shock may also be required.

It is important that the patient should be moved as little as possible whilst the fracture is unsupported, for secondary displacement of the fragments easily occurs and prejudices subsequent reduction of the fracture.

To immobilise a fracture in an emergency, some kind of a splint must be improvised usually from pieces of wood, which should be well padded with wool. The practitioner should have a number of Cramer's wire splints available, for they are light and inexpensive and can be bent to suit any fracture. Whatever the type of splint, the essential point is that it should be long enough. For a fracture at the ankle the splint should reach the mid thigh, for a fracture in the femur it should reach the axilla.

Treatment. To gain the best results the utmost care is necessary at every stage of treatment, and this involves constant supervision frequent expert examination and repeated radiographic control

Three main principles must be borne in mind —

(1) To reduce displacement.
(2) To maintain immobilisation until the bones are united.
(3) To conserve function of the joints, muscles and tendons.

Reduction of the Displacement. In "setting the fracture" end apposition and alignment of the bones should be secured These two desiderata are most important in fractures of the lower limb, where strength and stability are essential Of the two alignment is by far the more important, for a slight deviation from the normal axis may strain the knee or ankle, or predispose to such static deformities as flat foot.

The fracture may be reduced under general or local anæsthesia. For local anæsthesia, under strict asepsis a needle is inserted through the skin down to the hæmatoma at the site of fracture, and 2 per cent. *novocain* injected, in amount varying from 10 ml for a Colles fracture to 60 ml. for a fractured femur Pain is thus abolished spasm is at once relaxed, and the displacement can be more easily corrected.

In reducing the fracture any impaction of the fragments must first be undone. Then traction is applied in the long axis of the limb to correct shortening, and finally the bone ends are manipulated into place. The most effective manœuvres for particular fractures are described in the regional chapters.

After reduction, the position of the fragments must be checked by

palpation and by comparing the bony points. Radiographic confirmation must always be obtained, preferably before the anæsthesia is terminated

If the position is not satisfactory further manipulation must be carried out without delay If repeated manipulation fails, reduction must be effected by open operation

Immobilisation of the Fracture. With rare exceptions, fixation should be maintained until the bones are united. The time varies from three or four weeks in the case of a simple Colles fracture to three or four months in the average fractured femur These figures, and others in the regional chapters, are based on average cases, and the length of fixation must be varied according to the radiographic evidence in the individual case In general, the retentive apparatus should be kept in position until radiography shows well formed callus with commencing trabeculation

Fixation may be secured, according to the needs of the individual fracture, by splintage, by plaster of Paris, by traction apparatus or by nails, screws, plates or grafts introduced at open operation.

(a) *Various Special Splints* Formerly special splints, each known by the inventor s name, were advised for all types of fracture. Many of them are now regarded as inefficient and difficult to apply and they have been replaced in recent years by moulded splints of plaster of Paris. Such few splints as are in regular use are of simple construction and useful for several types of fracture. They include abduction splints for the shoulder and Thomas splints for the lower limb (Fig 203)

(b) *Plaster of Paris* Plaster of Paris may be used in two forms —

The moulded plaster splint is used typically for a Colles fracture and for other injuries of the forearm and wrist. The plaster bandage, after soaking in water until the bubbles cease to rise (about forty seconds), is gently squeezed free of excess of water and then unrolled and folded to and fro on a table to form a splint of the requisite length and width. From two to four 3-yard bandages are required, according to the size of the splint. Alternatively ready made plaster strips of suitable length may be used While still soft and pliable, the splint is applied directly to the skin of the limb (the fracture being already set), and firmly moulded to the shape of the limb It is then fixed in position, by a gauze bandage and its shape maintained until the plaster is hard.

The plaster spica is used especially for fractures of the leg and ankle (p. 208) Plaster splints are moulded to the sides and back of the limb, and then a circular bandage is applied, encasing the limb Before applying the plaster the limb must be padded with stockinette. The skin-tight plaster should not be used owing to the risk of compressing the blood vessels of the limb

(c) *Traction.* In fracture of the femur and to a less extent in other fractures, the fragments can be kept in position only by continuous traction, sufficient to overcome the shortening due to contraction of the long thigh muscles. The broken limb is placed in a splint, such as Thomas which supports it and can be adjusted to correct any lateral or antero-posterior displacement. Traction may be of fixed type, e.g. to the

after a fracture is just as important as to secure proper union of the broken bone.

It is now recognised that two conditions are to be observed if the function of the limb is to be conserved —

(a) The joints that have to be immobilised must be placed in the position which relaxes the weaker muscle groups. Thus the shoulder should be immobilised in 80 degrees abduction, the foot in 90 degrees dorsiflexion.

(b) Active use of the limb must be encouraged as soon as possible Thus in a Colles' fracture full use of the fingers, thumb and elbow is encouraged from the first; in a Pott's fracture the patient is allowed to walk in plaster within two weeks.

The effect of such active use is to maintain muscle tone and circulation Full use of the limb is regained rapidly after the splint is removed

Treatment of Compound Fractures In a compound fracture the first aim is to eliminate all contamination by treatment of the wound on the lines described on p 17 This can best be achieved in cases seen within the first eight hours.

The soft tissues are cleansed and the wound margins excised. If the bone ends are obviously contaminated, they are washed with saline, and spicules and small loose fragments may be removed. The bones are then manipulated into alignment and the wound is closed Penicillin should be given as a routine.

Amputation is indicated in compound fractures of the lower limb (1) if the main artery is torn and the nutrition of the extremity thereby imperilled (2) if the limb is so badly shattered that even with uneventful healing it will be less useful than an artificial limb.

Delayed Union and Non-union

These two terms indicate degrees of the same defect, impairment in the process of normal union. In some cases union is eventually satisfactory In others the bone ends become sclerosed, and all signs of callus formation cease. The bones are united by fibrous tissue, and in some cases a "false joint" develops.

Causes. (1) Separation of the bone ends, due to retraction of one of the fragments (e.g in fracture of the patella), to interposition of soft tissues, or even to over zealous traction.

(2) Faulty immobilisation, due to improper splintage, or to the anatomical difficulty of fixing a small bone (e.g the carpal navicular)

(3) Impaired blood supply to the bones (e.g fracture of the neck of the femur where the blood supply to the femoral head is compromised)

(4) Bone disease at the site of fracture (e.g a tumour or cyst)

Treatment. Where there is but slight delay in the process of union, all that is required in most cases is to immobilise the limb properly for a further period preferably in an unpadded plaster cast, and to encourage active use of the limb.

Operative treatment is indicated if these measures fail The site of fracture is exposed and cleared and a bone-graft is applied to secure complete immobilisation

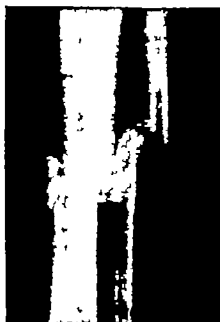


Fig 55 Ununited fracture of tibia and fibula six months after the injury The bone ends are sclerosed while the gap is filled with fibrous tissue, partly bridged by callus.

Pathological or Spontaneous Fractures

These terms are in common use as signifying fractures caused by slight trauma and involving a bone weakened by disease or atrophy

Predisposing Causes. *Generalised Affections of the Bones*

(*a*) Senile Atrophy A common example is fracture of the neck of the femur

(*b*) Atrophy of Disuse. A paralysed limb or any bone in a bedridden patient, is easily broken.

(*c*) Generalised diseases, such as congenital fragility osteitis fibrosa, rickets, osteomalacia.

Localised Affections

(*a*) Inflammatory lesions, e.g osteomyelitis, tuberculosis.

(*b*) Cysts and primary tumours, especially the giant cell tumour

(*c*) Metastatic tumours, e.g secondary to carcinoma of the breast, *kidney or thyroid.*

Diagnosis. The diagnosis of a pathological fracture may be suspected from the trivial character of the violence or from collateral evidence. It is confirmed by radiography

Treatment. The treatment is on the same lines as for a simple fracture. In some cases, e g following osteitis fibrosa or a cyst, union occurs, though slowly In others, e.g in secondary malignant disease, the treatment is obviously palliative.

Separation of Epiphyses

This injury occurs in adolescents before the epiphysis is united to the shaft of the bone. In most cases the break is not strictly at the epiphysial plate but through the young vascular bone immediately on its diaphysial aspect.

The clinical features are similar to those of a fracture. In some cases it may be observed that the line of separation is more exactly transverse and straight and that the crepitus is of a soft, muffled character. The age of the patient often gives a clue to the correct diagnosis, but often the injury can be distinguished from a fracture only by radiography.

The treatment is on the same lines as for a fracture and union takes place rapidly. Sometimes the lengthwise growth of the bone is interfered with and in paired bones considerable deformity may result.

CHAPTER 15

AFFECTIONS OF JOINTS

INJURIES OF JOINTS

Sprains. A sprain is characterised by tearing of some of the fibres of a ligament or of the synovial membrane or capsule, often accompanied by a serous or hæmorrhagic effusion into the joint.

There is a sudden, nauseating pain, followed by stiffness of the joint. Swelling rapidly develops in the soft tissues, and the joint may be distended by an effusion Bruising later becomes manifest.

On examination there is tenderness on pressure over the site of the tear which is generally close to one of the bony attachments of the ligament. Pain is caused by movement of the joint, and especially by such movements as put the affected ligament on the stretch

The diagnosis is to be made from a fracture close to the joint. Often this can be excluded only by radiographic examination

In mild cases it suffices to apply adhesive strapping If there is much swelling apply a firm bandage over a layer of cotton wool and elevate the limb for a few days. If the pain is severe it may be relieved by injecting 1 per cent. novocain at the site of injury It is claimed that this also hastens recovery from the sprain

Dislocations. The joints most often dislocated are the shoulder, the hip and the temporo-mandibular joint. In the shoulder the causative injury is not necessarily severe, but is sudden and unexpected so that the muscles controlling the joint are caught unprepared. In the hip on the other hand the bony configuration permits dislocation only as a result of severe violence.

The clinical features of the individual dislocations are described in the regional chapters.

Congenital dislocation is practically limited to the hip joint. It is described on p 175

Pathological dislocation results from disease of the joint or of its constituent bones. Three factors are involved in the displacement (1) destruction of part of the articular surface of one of the constituent bones, (2) laxity of the ligaments (3) spasm of the muscles. A pathological dislocation may result from tuberculous or other forms of arthritis, or from paralysis of one of the muscle groups acting on the joint. The hip is affected most often as a result of tuberculosis, but the knee, shoulder elbow and finger joints are also liable to be involved

Habitual or recurrent dislocation is almost limited to the shoulder and the temporo-mandibular joint. The causes and clinical features are given in the regional chapters.

ACUTE SYNOVITIS AND ACUTE ARTHRITIS

Acute synovitis and arthritis may result from a penetrating wound or from osteomyelitis of a nearby bone. This latter is most commonly seen in the hip joint.

The disease varies greatly in intensity, ranging from a simple acute synovitis, which may subside promptly, to a suppurative arthritis which if untreated affects all the components of the joint and leads to permanent damage.

Most types of acute arthritis respond well to antibiotics. The joint should be immobilised by a splint or traction apparatus

TUBERCULOSIS OF JOINTS

Like other manifestations of tuberculosis, joint disease is now becoming rare. It is now practically limited to the hip and occasionally the knee.



FIG 50. Tuberculosis of the elbow from a girl aged 18 who suffered from pulmonary tuberculosis. The joint outlines are blurred, the joint space is diminished owing to destruction of the cartilages, and the adjacent bony structure is decalcified.

The lesion is due to blood borne bacilli which settle either in the synovial membrane or in the bone close to the joint. The synovial membrane becomes thickened and spongy the articular cartilage softens and flakes off cavities form in the bone ends, the soft tissues over the joint become swollen.

The symptoms are insidious in onset. There is pain, especially on sudden movement of the joint, for example when the muscles relax in sleep There is stiffness, with limited movement of the joint. Swelling of the soft tissues may be apparent, especially in the knee. A cold abscess may form.

X ray examination shows blurring of the outline and reduction in the joint space, and perhaps a focus in the bone The diagnosis can be confirmed if necessary by biopsy of the synovial membrane.

The treatment has been revolutionised in recent years. Antibiotics and other drugs (streptomycin para amino salicylic acid, isonicotinic acid) arrest the progress of the disease. Operation may be required to remove diseased cartilage and synovial membrane, to curette out a bone focus, and to evacuate pus

RHEUMATOID ARTHRITIS

This disease occurs characteristically in women from 40 to 60 years of age. It may occur in children and be associated with glandular and splenic enlargement and general evidence of toxæmia (Still s disease) It affects multiple joints, especially those of the hands and fingers, and the smaller joints generally In severe cases nearly every joint in the body may be involved. The cause is not known

Pathological Features. The synovial membrane is involved first. It suffers an infiltration with lymphocytes, and becomes œdematous and swollen In some cases, especially in the knee, the synovial membrane projects into the joint in the form of numerous processes or *synovial villi*. Later the synovial membrane and capsule become fibrotic, and this leads to crippling deformities The articular cartilages, which are involved secondarily become atrophic and thinned. The bone ends also suffer atrophy Loose bodies may form in the joint, especially in the knee or shoulder

Clinical Features. Often there is a subacute onset, with fever malaise and severe pains in the joints The affected joints are swollen, tender and stiff *Contractures later develop and may cause permanent* crippling

Radiography shows diminution of the joint space, due to atrophy of the articular cartilages and consequent approximation of the bone ends. The bones themselves are atrophic and may become deformed by constant pressure

Treatment. The treatment of rheumatoid arthritis at present is far from satisfactory and is largely palliative. Medical measures include the use of salicylates and cortisone, and various forms of physiotherapy

The local treatment varies at different stages of the disease. In the early painful stages the affected joints should be kept at rest and protected from weight bearing In the later stages efforts must be made to increase the range of movement by physiotherapy and by immersion baths, in which the joints can be exercised painlessly Of the different forms of physiotherapy radiant heat, diathermy and short wave therapy all have their advocates Great care must be taken to prevent contractures.

OSTEO ARTHRITIS

This disease generally affects elderly persons but is by no means rare in younger adults. It mainly affects a single joint, especially a large one, such as the hip or knee. Many causal factors have been suspected. Trauma is undoubtedly an important factor either a single injury or a succession of minor ones. Sometimes occupational trauma is responsible, sometimes faulty stresses imposed as a result of a deformity, such as a mal united fracture, sometimes trauma caused by a loose body or a slipping meniscus.

The articular cartilages are principally affected. Where exposed to constant pressure or weight bearing they become atrophied and thinned and may be highly polished or "eburnated". The underlying bone similarly atrophies where compressed and may be deformed. In the knee synovial villi and loose bodies may form as in rheumatoid arthritis.

The main clinical feature is stiffness in the affected joint, worse in the morning and improved on exercise. Pain is a variable feature, and may be severe. On examination the range of movement is very limited while creaking is readily perceptible.

Radiography shows narrowing of the joint space, as in rheumatoid arthritis, and in addition there is "lipping" due to new bone formation at the margins of the articular surfaces.

In the great majority of cases conservative treatment is indicated along the lines described for rheumatoid arthritis.

If conservative measures fail to bring relief, operation may be considered. The type of operation varies for different joints, and is considered in the regional chapters.

HÆMOPHILIC ARTHRITIS

This affection results from repeated hæmorrhage into the joint. It is almost limited to true hæmophilics and therefore occurs only in males. The knee is generally affected.

The hæmorrhage may follow an injury or appear to be spontaneous. The joint is distended and painful. The temperature is raised to 100 F or even higher. The blood is gradually re-absorbed and the joint may return to normal, but after repeated hæmorrhages permanent changes resembling osteo-arthritis tend to develop. Contracture of the joint is an important and disabling complication.

Treatment. After a recent hæmorrhage the joint should be splinted in good position and compressed by an elastic bandage over cotton wool. Subsequently active movements are encouraged to prevent the formation of adhesions.

NEUROPATHIC ARTHRITIS

(Charcot's Joint)

This disease is characterised by gross destructive changes in the ends of the bones constituting a joint, with equally gross new bone

lost. Such bony ankylosis is quite painless and the disease generally heals completely

Treatment. If the joint is in good position it is often best left untreated Thus, in the case of the hip or knee, a sound ankylosis in good position causes little disability, and is infinitely preferable to an unstable, painful joint. In the shoulder ankylosis in optimum position (p 130) is well compensated by increased scapular movement. In the elbow on the other hand, an arthroplasty may sometimes be advisable, while in the temporo-mandibular joint, where movement is imperative, operation should always be advised

If the joint is ankylosed in an unfavourable position an osteotomy may be required to correct the alignment of the limb

Contracture

A contracture, of fixation of a joint in a position of deformity, may accompany either a true or a false ankylosis, fibrous or osseous. The *deformity is due to gradual shortening of the soft tissues on one aspect of the limb* Generally there is a flexion deformity combined at the shoulder or the hip with adduction. A severe contracture may lead to subluxation of the joint. The causes of contracture are —

(1) Various forms of arthritis, with muscle spasm followed by contraction of the more powerful muscle groups and adaptive shortening of the soft tissues.

(2) Paralysis of one group of muscles, e.g in infantile paralysis.

(3) Fibrosis of soft tissues, e.g from burns or from unknown cause, as in Dupuytren's contracture (p 102)

(4) Long-continued malposition, permitting adaptive shortening

Treatment. Gradual traction by weight and pulley is sometimes effective. Powerful skeletal traction may be needed Care must be taken to avoid over-stretching the main artery to the limb, and the circulation of the extremity must be carefully watched

Manipulation under anaesthesia is sometimes required. It should be performed with care to avoid fracturing a bone (easily done if the bone is atrophic) or over-stretching the artery

Division of the shortened structures (tenotomy and fasciotomy) may be carried out in conjunction with the above measures. A subcutaneous tenotomy may be performed by a thin bladed knife inserted blindly through a small incision but the open operation is often preferable. At the hip a somewhat similar procedure is the muscle-sliding operation, by which the flexor muscles and fasciae attached to the anterior part of the ilium are detached from their origins and slid downwards to permit correction of a flexion deformity

Osteotomy is required in some cases. Thus an osteotomy of the femur may be required in conjunction with tenotomy for adduction contracture of the hip

LOOSE BODIES IN JOINTS

Loose bodies occur most often in the knee and the shoulder, occasionally in the elbow and rarely in other joints They vary in number from one to a hundred and may occur in diseased or healthy joints The following are the main types —

Loose Body due to Osteochondritis Dissecans This condition occurs in the knee and rarely in the elbow The loose body is a portion of the articular surface, generally derived from one of the femoral condyles and its separation is thought to be due to a "dissecting osteochondritis" Probably the bone is partly loosened by an injury and later set completely free as a result of rarefying changes in the *subjacent* bone (Plate VI p 128)

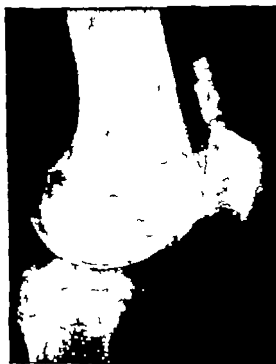


Fig. 58. Loose bodies in knee joint, associated with chronic arthritis.

Fibrinous Loose Bodies These are multiple small bodies like melon seeds or grains of rice. They occur in tuberculosis, osteo-arthritis and other joint diseases, and are due to inspissation of fibrinous exudate.

Fibro-fatty Loose Bodies These result from separation of synovial villi, the hypertrophied fringes of synovial membrane found in rheumatoid and osteo-arthritis

Bony and Cartilaginous Loose Bodies These occur mainly in rheumatoid and osteo-arthritis. They are often multiple, and are generally the size of peas or beans, though exceptionally they may grow much larger In some cases they originate as "synovial chondromata," masses of cartilage growing in the synovial membrane. Their mode of formation is unknown.

Clinical Features. Many loose bodies, especially those of fibrinous

type associated with extensive joint disease, give rise to no recognisable symptoms. Others, however, may cause severe pain and much disability.

The characteristic picture is of recurring locking of the joint as the loose body becomes impacted between the joint surfaces. The locking may be quite temporary but it causes intense sudden pain which may shoot down the limb and is followed by swelling due to effusion into the joint. If recurrent, the effusion leads to softening of the ligaments and instability of the joint. Disuse leads to muscle atrophy especially in the case of the quadriceps femoris in affections of the knee.

On examination the loose body may sometimes be palpable, especially if large, but more often there is no direct evidence of its presence.

Diagnosis. The diagnosis is to be made from arthritis with thickened synovial fringes, and in the case of the knee, from a lesion of the semilunar cartilages. The diagnosis is assisted by radiography which reveals a large proportion of symptom producing loose bodies (Plate VI opposite). If a shadow is present, but of doubtful nature, it is sometimes helpful to distend the joint with oxygen and repeat the radiographic examination when the precise relation of the shadow to the joint will be revealed.

Treatment. The loose body should be removed. Its position within the joint should be demonstrated by stereoscopic radiographs taken immediately before operation. If the body is deeply placed a wide exploratory incision is required.

If the loose body should be palpated in a superficial position, the best plan is to fix the limb immediately on a back splint, so as to keep the body in that position until operation can be carried out. It is sometimes recommended to transfix the body with a needle to keep it temporarily in place.

PLATE VI



Osteochondritis dissecans of medial condyle of femur



Multiple loose bodies in the knee





CHAPTER 10

THE SHOULDER GIRDLE AND ARM

Examination of the Shoulder Region

THE shoulder region is examined with the patient stripped to the waist and seated

Inspection and Palpation. First the general contour of the shoulder is inspected and compared with that of its fellow The shoulder may be raised in congenital deformities, depressed as a result of paralysis of the levator muscles, or there may be wing scapula from paralysis of the serratus anterior Its contour may be unduly rounded owing to effusion into the joint, or unduly angular owing to dislocation or a fracture near the joint.

Next, the various bony points are inspected and palpated, the latter part of the examination being best carried out while standing behind the seated patient. The whole length of the clavicle, the acromion process and the spine of the scapula are first palpated. The head and neck of the humerus are palpated from the axilla, the dense axillary fascia being relaxed by adduction of the arm. The great tuberosity, which lies in the same line as the lateral epicondyle, can be palpated indistinctly under cover of the deltoid and can be felt to move as the arm is rotated. Throughout this examination the shoulder is compared with its fellow

Movements. All movements should be tested and compared with the sound side When the shoulder joint is being examined, the scapula must be fixed by gripping above the shoulder or by holding its inferior angle.

The most important movement to test is abduction which is impaired in many injuries and diseases in this region. Abduction is produced by movement at three joints, the shoulder the acromio-clavicular and the sterno-clavicular Normally throughout the range of abduction movement takes place at all three joints, though mainly at the shoulder If the scapula is fixed so that movement occurs only at the shoulder joint the arm can be abducted only to 80 degrees. This movement is effected by the supraspinatus and deltoid muscles the former initiates the movement and also pins the head of the humerus into the glenoid cavity while the deltoid continues the movement. If the supraspinatus is out of action the deltoid cannot carry out the initial movement, and there is marked difficulty in abducting the arm from the side until the trick is learnt of swinging it through the first 15 degrees.

The full range (90 degrees) of movement at the shoulder is only obtained when the arm is laterally rotated so that the greater tuberosity does not abut against the acromion process. For this reason when the arm is to be immobilised in abduction it should also be rotated laterally

In addition the arm should be placed at an angle of 30 degrees in front of the coronal plane.

A range of abduction greater than 80 degrees is obtained by movement at the acromio-clavicular and sterno-clavicular joints, associated with rotation of the scapula and elevation of the whole shoulder, brought about by the correlated action of the serratus anterior and trapezius muscles. The range of movement at these two joints is so extensive that there is remarkably little functional disability, even if the shoulder joint is completely ankylosed provided that it is ankylosed in optimum position.

INJURIES IN SHOULDER REGION

Fracture of the Clavicle

This is one of the commonest of fractures, for the clavicle acts as a buttress to the shoulder region, and is therefore peculiarly subject to strain.

The fracture generally results from a fall on the shoulder or on the outstretched hand. The violence is transmitted through the shoulder and scapula, and exerts a bending or twisting strain on the clavicle. Nearly always the bone is fractured in its middle third, at the point of greatest weakness where the two main curves of the bone meet. The line of fracture is oblique and directed from above downwards and medially The fracture is simple in type and very rarely gives rise to complications.

The displacement is characteristic. The shoulder lacking the buttress normally provided by the clavicle, is pulled down by the weight of the arm and sags medially and forwards towards the chest wall. As a result the lateral end of the clavicle is drawn downwards, so that it lies tilted obliquely, and it is also displaced medially, so that it is overlapped by the medial fragment. The latter is tilted upwards by the pull of the sterno-mastoid muscle. These displacements are readily palpable and may be visible.

Treatment. A fractured clavicle unites readily without special care, and the whole aim of treatment is to ensure that the union occurs in reasonably good position

The fracture can be reduced readily under local anæsthesia by bracing the shoulders back and raising the shoulder on the affected side, but the difficulty is to maintain the position. For this purpose numerous methods have been described, none altogether satisfactory

The most satisfactory method for general use is to apply a figure-of eight bandage so as to brace the shoulders back. A large pad of wool is placed in front of each shoulder extending to the axillæ, and several long bandages, 6 inches wide, are then applied, passing in front of the shoulder back under the axilla and then across the scapulæ to the opposite side. The bandages should be stitched to prevent slipping and should be re-applied every few days as they loosen. For the first week the elbow is supported in a sling tied over the opposite shoulder

The bandage is discarded after three weeks. The finger, wrist and elbow joints must be exercised actively from the first.

Dislocation of the Sterno-clavicular Joint

This dislocation is rare, for the ligaments controlling the joint, especially the costo-clavicular or rhomboid ligament, are very strong and injuries in this region are far more apt to cause fracture of the relatively delicate clavicle.

The treatment of an anterior dislocation is to reduce the displacement and to apply a small felt pad over the joint, fixing it with adhesive strapping A sling is then applied to support the elbow Recurrence of the displacement is common but nevertheless there is little disability If demanded for cosmetic reasons, operation may be performed in order to hold the medial end of the clavicle in place by anchoring it to the sternum or the second costal cartilage with a strip of fascia lata.

An upward dislocation is treated similarly A posterior dislocation may prove difficult to reduce, and operation may be required in order to lever the end of the clavicle from under cover of the manubrium sterni.

Dislocation of the Acromio-clavicular Joint

This injury generally results from a fall on the shoulder The acromion *is forced downwards and the lateral end of the clavicle rides up and projects* on the upper aspect of the shoulder In complete dislocation the conoid and trapezoid ligaments which bind the clavicle to the coracoid process, are torn



Fig 59. *Dislocation* of the acromio-clavicular joint, of three week s dura tion. The disloca tion could be reduced easily but promptly recurred. It caused no disability and no treatment was required.

The dislocation causes some difficulty in lifting the arm and some limitation of the movements of the shoulder It is easily reduced by raising the arm and manipulating the two bones into place, but it tends to recur as soon as the arm is allowed to hang

The treatment is to fix the clavicle down to the coracoid process by means of a screw

Dislocation of the Shoulder

The wide range of movement and the lack of support from bony configuration render the shoulder joint very liable to dislocation. In the great majority of cases the injury results from a sudden, unexpected and forcible abduction of the arm—for example, in a fall on the out

stretched elbow or hand. The element of surprise is an essential feature, for the shoulder owes its integrity largely to the protection of the muscles controlling it, and if they are taken unawares the head of the humerus easily slips out of the glenoid cavity In rare cases dislocation follows a minor strain—for example, in throwing a cricket ball.



FIG 60 Dislocation of the shoulder The head of the humerus is in the subcoracoid position (see inset). From a photograph of an untreated case, after the initial bruising and swelling had subsided.

When the arm is suddenly abducted in lateral rotation the head of the humerus is forced downwards, stretching the capsule at its weakest point on the inferior aspect of the joint, where the capsule is loose and unprotected by muscle. The head of the humerus then comes to lie on the axillary border of the scapula just below the glenoid, and it may remain in this position (*subglenoid dislocation*) with the arm held by spasm in extreme abduction (luxatio erecta) Generally the head of the humerus is then forced medially and forwards, tearing through part of the subscapularis muscle, and comes to rest in front of the neck of the scapula (*subcoracoid dislocation*) Occasionally it passes still further in the same direction (*subclavicular dislocation*) Rarely the head of the humerus passes backwards, tearing the teres major and infraspinatus, and comes to rest behind the scapula (*subacromial and subspinous dislocations*) This last variety may occur in an epileptic fit or during convulsive therapy

Clinical Features. Dislocation of the shoulder causes much pain and a certain amount of shock. Often there is a great deal of bruising in the shoulder region and in a stout patient the diagnosis may be difficult.

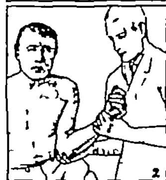
The movements at the shoulder are impaired, and the arm is held fixed, with the elbow abducted a little from the side. On examination the rounded contour of the shoulder is lost, the acromion stands out prominently and the deltoid below this point is flattened. There is a fullness below the coracoid process, and in a thin patient the head of

the humerus can be felt in this situation The diagnosis should be confirmed by X-ray examination, which serves also to exclude a coincident fracture

Treatment. In recent cases reduction presents little difficulty The classical method is to place the unbooted heel in the axilla, exert gradual traction on the arm (using the bent elbow as a lever) and finally to rotate it medially so as to direct the head of the bone towards the gap in the capsule.



In Kocher's method (Fig 61) the arm is rotated laterally to stretch the subscapularis muscle, thus freeing the head of the humerus from contact with the scapula. The elbow is then brought in front of the chest to lever the head outwards, and finally the arm is rotated medially to direct the head towards the glenoid cavity



Either of these methods can be done in the conscious patient, but there is considerable though transitory pain so anæsthesia is often preferred, though it may involve a delay of a few hours if the stomach is full. The following method is simpler and can usually be carried out without anæsthesia and with little or no pain. The patient is placed prone on a table, with the affected arm dependent at the side, so that its weight overcomes all muscle spasm. After he has been left in this position for several minutes, gentle rotatory movements of the arm will return the head of the humerus to the glenoid.



Fig 61 Kocher's method for reducing a dislocation of the shoulder

After reduction by any of these methods, the arm should be supported in a sling and fixed by a body bandage applied over a generous pad of wool in the axilla. After a few days the bandage is removed and active movements are encouraged, but abduction beyond a right angle should not be allowed for fully a month. The full use of the shoulder should be regained within two months. In dislocation of long standing reduction may be difficult and dangerous.

Complications. *Fracture of the Greater Tuberosity* This complication is not infrequent. If the fragment is so displaced that it does not pass under the acromion on abduction it should be replaced by open operation.

Fracture of the Neck of the Humerus This is the combined injury generally known as 'fracture-dislocation.' It is described on p. 185

Injury to Nerves The dislocated head of the humerus may press upon any of the nerves passing through the axilla, most frequently upon the axillary (circumflex) nerve, which is liable to injury owing to its fixity and its proximity to the humerus. As a result the deltoid is paralysed, and the arm hangs in the adducted position close to the side. The treatment, after reducing the dislocation, is to place the arm in an abduction splint and to apply electrical stimulation to the paralysed muscle until the nerve regenerates. The condition responds well to prompt treatment, and recovery should be complete within four to six months.

Recurrent or Habitual Dislocation. Dislocation of the shoulder shows a special tendency to recurrence. Once the tendency is acquired the dislocation may recur frequently, after trivial strains—for example, when throwing a ball or when putting up the back hair It is thought that the main source of weakness is that the labrum glenoidale is torn away from the anterior rim of the glenoid cavity Another factor is a bony defect on the posterior aspect of the head of the humerus. Many operations have been devised for recurrent dislocation The one now generally recommended is Bankart's, in which the labrum is re-attached to the glenoid by sutures

Fracture of the Neck of the Humerus

This is a common fracture, both in children and adults. It may result from a direct injury such as a fall on the shoulder or from an indirect injury, such as a fall on the outstretched hand In the great majority of cases the fracture passes through the surgical neck, immediately below the greater tuberosity Rarely it passes through the anatomical neck. In adolescents the fracture may pass through the soft growing bone just distal to the epiphysial cartilage (*separation of the epiphysis*).

The fracture may be a simple crack without displacement, or the lower fragment may be displaced to the medial or the lateral side according to the direction of the blow Not infrequently the bones are comminuted and impacted, and, in addition, the greater tuberosity may be broken.

In the majority of cases there is no great displacement of the fragments. Occasionally there is displacement with adduction or with abduction (Fig 62)

Treatment. (1) If there is no marked displacement, reduction should *not* be attempted, for anatomical reposition is unimportant and as the fragments are usually impacted they are better left undisturbed. The main principle is to conserve the function of the shoulder for if the shoulder is immobilised for more than a short time, it is peculiarly apt to become stiff from "adhesions" (p 137), and, in addition, the deltoid muscle quickly becomes atrophied and the power of abduction is impaired. As a routine, the arm should be well padded and bound to the side with a wide bandage for a few days to relieve pain, and thereafter allowed to swing free, suspended only by a sling or a collar and

cuff Active movements are encouraged and physiotherapy is carried out to prevent stiffness

(2) When there is marked displacement, reduction is carried out under anæsthesia. If the bone then remains in place, with no tendency to redisplacement, the treatment described above is instituted If however the fracture remains unstable the limb is placed on an abduction splint in 80 degrees abduction for about two weeks.

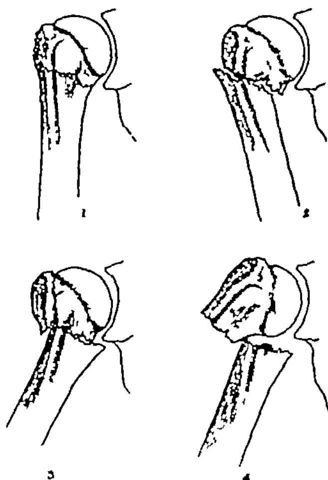


FIG. 62. Fractures of the neck of the humerus. (1) Transverse fracture without displacement. (2) Oblique fracture with little displacement. (3) Fracture with separation of greater tuberosity (4) Fracture with marked displacement.

Fracture-Dislocation. In this injury there is a fracture of the neck of the humerus, and the small proximal fragment is displaced through a tear in the joint capsule. The injury is generally due to a fall on the outstretched hand, or occasionally due to falling directly on the shoulder

Clinical examination is rendered difficult by the amount of bruising usually present, and the exact nature of the injury is only made clear by X ray examination

The treatment may be difficult, and the functional end result is often poor Even if reduction is successfully effected, there is great liability to stiffness of the joint, and sometimes the small proximal fragment, which is freed from all its connections, undergoes necrosis. Often, in addition there is an injury to

the axillary (circumflex) nerve, which further delays the restoration of function

Manipulative reduction of the displacement should be attempted first. The arm is raised laterally into a position of over-abduction and powerful traction applied in its long axis while attempts are made to push the loose head back into the joint. If this fails operative reduction is attempted, though there is a risk of necrosis of the humeral head

Fracture of the Shaft of the Humerus

This is a common injury which may occur at any age. The fracture may be spiral, from rotational strains, or oblique or transverse from angulating strains.

The displacement varies If the fracture is situated above the level of the deltoid insertion, the short upper fragment is generally adducted by the pectoralis major muscle, while the lower fragment is drawn up

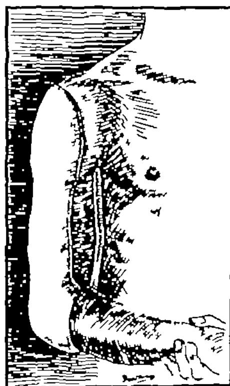


FIG. 63. Fracture of shaft of humerus. Plaster of Paris strip applied.

on its lateral side by the pull of the biceps, triceps and deltoid. If the fracture is situated below the deltoid insertion, the displacement depends mainly upon the direction of the fracturing force, and is therefore variable.

The fracture is generally of simple type, with little or no comminution. Impaction is rare. The deformity the abnormal movement at the site of fracture, and the presence of crepitus render the diagnosis obvious.

In the clinical examination the most important point is to note the presence or absence of radial nerve paralysis (see below)

Treatment. Reduction is effected without difficulty Accurate

end apposition is not essential Since there is little tendency to over riding it is not necessary to apply traction.

The arm is splinted by Gooch splinting or, preferably by plaster of Paris and the wrist is supported by a collar and cuff sling If plaster is used an unpadded strip 4 inches wide and about 24 inches long may be moulded down the lateral surface of the arm round below the bent elbow and up the medial surface Whilst the plaster is soft it is moulded to the bony prominences, and fixed in position with a bandage.

Under such treatment nearly all spiral and many transverse fractures heal rapidly and the plaster may be removed after ten weeks If at this time there is still movement at the site of fracture, further immobilisa tion, thorough and prolonged, is necessary to avoid non union The most satisfactory method is to apply a plaster spica including the trunk, arm and elbow, and to maintain this fixation until union is complete—sometimes for four or five months.

Radial Nerve Involvement. The radial (musculospiral) nerve is very liable to injury owing to its close relation to the lower half of the shaft of the humerus. Nearly always the injury is a ' lesion in continuity in which the nerve is contused but not divided. The paralysed muscles include the brachioradialis and the extensors of the wrist and fingers the damage is recognised at once by the presence of drop wrist.

When the paralysis is noted a splint is applied with the wrist in dorsiflexion, and electrical stimulation of the paralysed muscles in stituted. The brachioradialis is the first muscle to recover If in four months there is no evidence of recovery it must be presumed that damage is more than a simple contusion, and open operation should be performed to unite the divided ends.

Pain and Stiffness of Shoulder ("Frozen Shoulder")

Pain and stiffness of the shoulder are natural and inevitable features of major injuries in this vicinity but in addition they are very common complaints in middle aged and elderly people who give no history of a major injury Sometimes there is a rheumatic history and there may be signs of arthritis in other joints, while X ray examination may reveal similar changes in the shoulder itself.

In other cases, the condition may be attributed to fibrositis, or perhaps to chronic disease of the subacromial bursa. In these conditions it is much easier to offer the diagnosis than disprove it.

Finally a lesion of the supraspinatus tendon is not uncommon

Complete rupture of the supraspinatus tendon may accompany fracture of the humerus or dislocation of the shoulder or it may occur alone as a result of a sudden forceful abduction strain. The function of the supraspinatus muscle is to initiate abduction the deltoid assumes control when the arm is abducted through 15 degrees. Consequently the main effect of rupture of the tendon is that the arm cannot readily be abducted from the side until the trick is learnt of swinging it outwards through the first 15 degrees or so

The treatment is to repair the ruptured tendon by open operation.

If operation is contra indicated, the arm should be put on an abduction splint for eight or ten weeks.

Partial rupture of the supraspinatus tendon may result from quite minor strains. The injury occurs at the attachment of the supraspinatus tendon to the upper part of the greater tuberosity. It causes pain in the region of the tuberosity, most marked on abducting the arm almost to a right angle.



FIG. 64 Calcification of Supraspinatus tendon.

Calcification of the supraspinatus tendon may follow a partial rupture, or occur in persons who give no history of injury. The symptoms are very similar to those of a partial rupture. X ray examination may reveal the condition. There is a thick paste of calcified debris in the tendon and sometimes in the subacromial bursa. It may be flushed out with a syringe, or exposed and evacuated with a curette.

Treatment. Apart from measures directed to the particular cause, various symptomatic forms of treatment may be advised. The local application of heat is most valuable. This may be done by the use of warm clothing and, when in bed by an electric blanket, while diathermy and infra red rays achieve the same purpose more convincingly.

Active movement should be encouraged and indeed powerfully enjoined, and, in particular attempts should be made to increase the movements of abduction and rotation. Forceful passive movements, contrariwise, are harmful and dangerous.

Finally, if there is a localised area of tenderness, much benefit may be given by injecting a local anaesthetic such as procaine. Recently local injection of hydrocortisone has also been advocated.

Referred Pain in the Arm

This common complaint of middle aged people may be caused in many ways. Referred pain of myocardial origin occurs mainly down the medial aspect of the arm, as does referred pain from lesions of the breast, such as fibro-cystic dysplasia or even cancer. Referred pains from the shoulder joint are mainly located in the shoulder region, and restriction of movement in the joint usually points clearly to the origin.

There remain three diseases which may be responsible for pain of diverse distribution, namely cervical spondylosis, the thoracic outlet syndrome and the carpal tunnel syndrome. They are considered on pp 103 800

Rupture of the Biceps

The biceps may rupture either in its muscular belly or close to the upper end of the tendon of the long head.

Rupture of the muscle belly results from a sudden violent con traction. There is a sudden severe pain, with weakness of the elbow movements. A tender hæmatoma develops at the site of rupture, while attempts to flex the elbow lead to the appearance of a lump in the upper part of the arm—the contracted upper half of the muscle. The treatment is to expose the muscle and suture it.

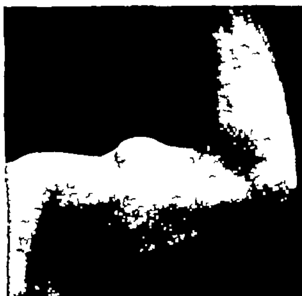


FIG. 65. Rupture of the long head of the biceps.

Rupture of the tendon of the long head generally occurs when the tendon is atrophic as a result of arthritis of the shoulder joint. There is tenderness over the bicipital groove, while attempts to flex the elbow cause pain and render the contracting muscle prominent (Fig 65) In many cases, however there is remarkably little disability Often no treatment is necessary If there is much pain or loss of power the muscle may be attached proximally to the periosteum in the bicipital groove.

WING SCAPULA

In this condition the vertebral border and lower angle of the scapula are prominent, and the scapula is rotated so that its lower angle approaches the midline. The condition is due to paralysis of the serratus anterior muscle, and the deformity is increased by efforts to perform pushing movements, during which the serratus normally should draw the scapula forwards against the chest wall.



FIG 66. Wing scapula, in a woman aged 53, who had sustained a dislocation of the cervical spine in an automobile accident, with compression of the 7th cervical nerve root. Note that the deformity is exaggerated by pushing movements with the arm raised to shoulder level, as the paralysed serratus anterior fails to stabilise the scapula.

The condition is due to a lesion of the long thoracic nerve of Bell which is injured in dislocation of the fifth sixth or seventh cervical vertebræ, or in the course of operations on the axilla, or stretched by downward traction on the shoulder in carrying heavy weights.

The disability is small and active treatment is often unnecessary. If desired fascial grafts may be introduced to anchor the vertebral border of the scapula to the lower cervical and upper dorsal spines.

CHAPTER 17

THE ELBOW REGION

Examination

Throughout the examination the elbow should be compared with its fellow. Inspection should be carried out first, and any alteration in the contour or other visible abnormality noted. Particular attention should be paid to the "*carrying angle*". This is an angulation of about 165 to 170 degrees, open laterally, which is normally present in extension, but disappears on full flexion. The angle may be altered as a result of a fracture of one of the condyles of the humerus (cubitus valgus or cubitus varus).

Palpation of the elbow region is carried out on a definite plan. First the subcutaneous surface of the ulna is traced up to the olecranon, then the two epicondyles are defined, and their relations to each other and to the olecranon noted. Normally in full extension the three points lie in a straight line, while in full flexion they form the points of an equilateral triangle. The lower end of the humerus may be traced up from the epicondyles, and is best palpated along the lines of the inter muscular septa. Finally the head of the radius is palpated on the dorsal aspect of the limb about 2 cm. below the lateral epicondyle, where it can be felt to rotate when the forearm is pronated and supinated.

The last part of the examination is to test the movements of the elbow active and passive, and to compare them with those of the sound side.

INJURIES IN THE ELBOW REGION

Supracondylar Fracture of the Humerus

This common fracture occurs most often in children and is generally due to a fall on the outstretched hand. The fracture is a transverse or oblique one, an inch or so above the lower end of the humerus. The lower fragment, carrying with it the whole elbow and forearm, is displaced backwards by the force of the blow and is then tilted by gravity and the pull of the triceps muscle. The lower end of the upper fragment consequently projects forwards, and may rupture some of the fibres of the brachialis muscle and may distort the brachial artery.

The elbow is held at an angle of about 120 degrees, with the wrist supported by the other hand. The whole elbow region is greatly swollen and bruised and there is a considerable amount of pain. The contour of the elbow region is altered by the backward displacement of the lower fragment, but the relation of the three bony points (the olecranon and the epicondyles) is unaltered, a point of distinction from dislocation. If the swelling is not too great, the sharp lower end of the

upper fragment may be palpated in front, above the level of the skin crease at the flexure. Crepitus can generally be elicited. The radial pulse may be absent.

Diagnosis. The diagnosis is to be made from dislocation of the elbow, separation of the humeral epiphysis and intercondylar fracture.

In dislocation there is greater fixity of the part, the relationship of the bony points is altered, and there is no crepitus. Separation of the lower humeral epiphysis can rarely be distinguished, except by radio-

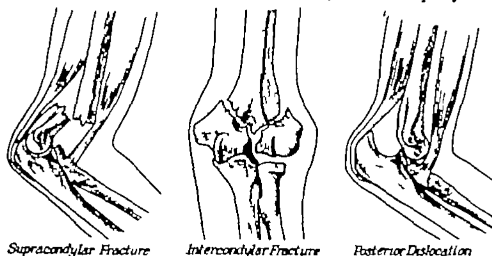


FIG. 67 Three common injuries in the elbow region.

graphy An intercondylar fracture can usually be suspected from the broadening of the elbow region produced by the lateral displacement of the fractured condyles.

Complication. This is notoriously the fracture most liable to the complication of Volkmann's ischæmic contracture (p 147)

Treatment. The fracture should be reduced under general anæsthesia without delay To reduce the fracture the elbow is held in right-angle flexion and pronation, and the fragments are manipulated into position by traction and forward pressure. Care must be taken to correct any lateral angulation. The forearm is then flexed as fully as the swelling permits and pronated so that the hand approaches the opposite sterno-clavicular joint, where it is fixed by suspending the wrist in a collar and cuff Often it is an advantage to apply a slab of plaster in direct contact with the skin on the dorsal aspect of the elbow region to keep the fragments in position. The alignment must be checked by radiography and rectified if necessary Repeated manipulations may be required.

Special care must be taken that the circulation is not impeded by œdema in the antecubital space, lest Volkmann's contracture should develop (p. 147) If necessary the wrist may be lowered to open out the elbow On no account should the elbow region be compressed by bandages or splints.

The limb should be kept completely at rest for three or four weeks.

Thereafter active movement should be encouraged. Passive movement and massage should not be employed, for they predispose to stiffness of the elbow

Intercondylar Fracture of the Humerus

This injury results from a severe blow or a fall on the point of the elbow There is a supracondylar fracture, with in addition a vertical split extending down to the joint. The line of fracture is T or Y-shaped The condyles are displaced laterally and separated and the shaft of the humerus may be driven down between them

The treatment is difficult and the end result usually poor The best method is to reduce the displacement under general anæsthesia by applying manual traction to the forearm and moulding the fragments into place. A plaster bandage is then applied from shoulder to wrist, with the elbow either straight or partly flexed.

Fracture of one Condyle of the Humerus

Either condyle may be fractured by a direct blow or by a fall on the hand occurring in such a way as to force the forearm into adduction or abduction. The lateral condyle is fractured more often than the medial condyle.

The line of fracture passes obliquely upwards from the articular surface so that the fragment is roughly triangular in shape. In the case of the medial condyle, the fragment is but little displaced and consequently the relationship of the bony points at the elbow is not greatly altered. The lateral condyle on the other hand, is usually displaced and rotated into bad position. The diagnosis is to be made from the other types of fracture in this region. If there is much swelling the distinction can only be made by radiography

Complications. If the displacement remains uncorrected or any secondary displacement is allowed to occur the alignment of the elbow joint is impaired and the "carrying angle" is altered, leading to cubitus valgus or cubitus varus These deformities are unsightly and may cause some disability In cubitus valgus which is generally due to fracture of the lateral condyle, the most important result is that the ulnar nerve is stretched over the medial condyle This may lead to the development of late ulnar neuritis (p 71)

Treatment. To avoid the complications mentioned above, the displacement must be completely corrected, preferably by open operation.

The fragment should be fixed in place by means of a stainless steel nail

Separation of Lower Humeral Epiphyses

These injuries occur in children, usually between the ages of 5 and 18

The *combined epiphyses of trochlea and capitulum* may be displaced and rotated forwards as the result of a fall on the point of the elbow The treatment is to extend the elbow fully and keep it in this position for three weeks.

The *epiphyses of the lateral condyle* may be but little displaced, or may be rotated laterally and round a vertical axis by the pull of the extensor muscles. Accurate reduction is essential (by manipulation or operation) to prevent the development of cubitus valgus and consequent risk of delayed ulnar neuritis.

The *medial epicondyle* is commonly avulsed by traction by the common flexor origin in valgus strains of the elbow Sometimes the medial collateral ligament also is torn. As the joint is momentarily opened on the medial side, the epicondylar fragment, rotated through

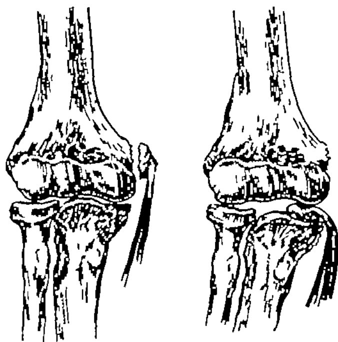


FIG 68 Separation of medial epicondyle with displacement into joint.

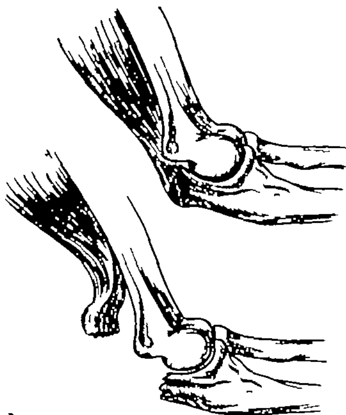


FIG. 69 Fracture of the olecranon. (a) Small fragment with no displacement. (b) Large fragment with marked displacement.

90 degrees, may come to lie within the joint in the hollow of the ulna. Often the ulnar nerve also is injured

The fragment may be extracted from the joint by applying faradic stimulation to the common flexor muscles. Failing this, operative reduction is necessary The wrist should be supported in a collar and cuff sling for a few weeks

Fracture of the Olecranon

Unlike other fractures in the elbow region fracture of the olecranon occurs mainly in adults. It generally results from a fall on the bent elbow If the triceps insertion remains intact there is no displacement and little treatment is necessary beyond a bandage and a sling for a week or two If the triceps insertion is torn, the fragment is displaced and the treatment is to operate without undue delay The fragment is brought down into position and fixed to the shaft of the ulna by silver wire or a screw The limb is then supported in a sling with the elbow bent to a right angle. Active movements are started a fortnight later

Fracture of the Head of the Radius

The head of the radius is usually fractured by being thrust forcibly against the capitulum of the humerus as a result of a fall on the pronated

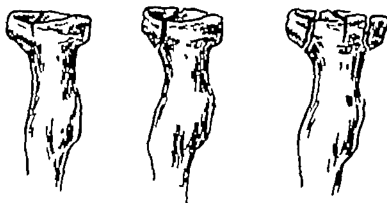


FIG. 70 Fracture of head of radius. (*a*) Vertical crack. (*b*) Marginal fracture without displacement. (*c*) Comminuted fracture.

hand Usually there is a "marginal fracture"—a vertical crack near one edge of the articular surface with or without displacement of the marginal fragment. Less often the head of the radius is comminuted or completely separated from the shaft.

There is tenderness on pressure over the head of the bone, with swelling due to effusion into the joint. Pain is elicited by forcible extension of the elbow and by pronation-supination movements, and the range of these movements is restricted.

The treatment must be varied according to the type of fracture. A simple marginal fracture with little displacement is treated by supporting the forearm in a sling for two or three weeks and by instituting active movements from the first. In adults, if there is much displacement or comminution, the radial head should be removed at an early stage.

Dislocation of the Elbow

This is a common injury, both in children and in adults.

The common posterior dislocation follows a fall on the outstretched hand. *The forearm is forced into hyperextension, tearing the anterior and lateral ligaments of the joint.* The olecranon, impinging against the humerus, now acts as a fulcrum, and the coronoid process is levered *posteriorly over the lower end of the humerus.* *Once the dislocation is* complete, the forearm is drawn into a semiflexed position by contraction of the biceps and the brachialis, and the coronoid process comes to lie in the olecranon fossa.

Clinical Features. The forearm is held semiflexed and immobile. There is considerable pain, increased on attempts to move the joint. The elbow region is greatly swollen and deformed. The olecranon is unduly prominent at the back, while the lower end of the humerus projects in front. The antero-posterior diameter of the elbow is consequently much increased The relation of the olecranon to the epicondyles is markedly abnormal.

Complications. The following complications may occur (1) fracture of the coronoid process; (2) rupture of the brachialis insertion, (3) pressure on the median nerve or the brachial artery (4) myositis ossificans (p. 148)

Treatment. The dislocation is reduced under general anæsthesia. The forearm is flexed to a right angle, and reduction is then effected by traction and gentle manipulation. Every effort must be made to avoid damage to the brachialis muscle or the vessels of the cubital fossa, *owing to the risk of myositis ossificans and of ischæmic contracture.*

After reduction the arm is supported in a sling for three or four weeks.

Dislocation of the Head of the Radius

Dislocation of the head of the radius occurs, usually from a fall on the outstretched hand, when the annular ligament is torn, so that the head of the radius slips forward in front of the capitulum of the humerus. It can be palpated in its abnormal situation, and may be felt to rotate when the arm is pronated and supinated

The treatment is to reduce the *dislocation under anæsthesia.* Sometimes there is also a fracture of the upper third of the ulna (Monteggia fracture) It should be reduced and fixed by a screw plate.

Subluxation of the Head of the Radius

This condition of "pulled elbow is common in young children *learning to walk.* It is produced when, to save the child from falling

his hand is suddenly jerked while in the position of pronation The sudden traction strain pulls the radius distally, so that the head of the bone slips partly out of the annular ligament. The limb is held immobile, slightly flexed and in mid pronation, and attempts to move it cause pain

The treatment is to flex and supinate the forearm and thrust it proximally in order to screw the head of the radius back into position A click may be heard as the bone slips back into place No after treatment is required

Volkmann's Ischæmic Contracture

This is a contracture which affects the flexor muscles of the forearm and causes great deformity and permanent disability It occurs as a complication of injuries in the elbow region, especially supracondylar fracture. The contracture results from the obstruction of the blood supply to the flexor muscles of the forearm due to pressure by the displaced bone fragment, by a hæmatoma under tension in the confined space of the antecubital fossa, or, occasionally by constricting bandages. Deprived of their blood supply, the muscles undergo coagulative necrosis, degenerate and are replaced by fibrous tissue which subsequently contracts. A similar lesion may occur in the leg

Clinical Features. The possibility of ischæmic contraction should be suspected if pain persists more than a few hours after the fracture has been set. Normally the pain should subside rapidly and its persistence demands immediate investigation. On examination at this stage, the fingers are white or blue and numb and cold, and their movements are impaired. The muscles of the forearm are brawny and indurated, and the whole elbow region is swollen. The radial pulse is impaired or absent.

Later the characteristic deformity develops. The fingers become flexed at the interphalangeal joints and hyperextended at the metacarpo-phalangeal joints, and eventually the wrist also becomes flexed and the forearm pronated. Since the tendons remain free from adhesions, the fingers can be straightened to some extent when the wrist is further flexed.

Prevention. In all injuries in the elbow region, and especially in supracondylar fracture, the risk of Volkmann's contracture must be borne in mind. The fracture must be reduced completely as soon as possible, and every care taken to obviate pressure on the antecubital fossa. The elbow must not be acutely flexed, and no constricting bandage or splint applied.

More important still, the limb must be watched carefully during the first forty-eight hours, and if pain persists or if the fingers show signs of impaired circulation, further steps must be taken to obviate pressure. All bandages are removed, the flexion at the elbow diminished, and the whole limb raised to reduce the swelling If the pain and circulatory impairment still persist, free incisions should be made over the antecubital fossa to evacuate blood clot.

It must be emphasised that the critical phase *is during the first* forty-eight hours. After this period treatment is often ineffective

Traumatic Ossifying Myositis at the Elbow

This is a condition in which ossification occurs in the brachialis insertion in front of the elbow, as a result of a tear of the insertion, with liberation of osteoblasts. It usually follows a dislocation of the elbow

The new bone begins to appear within a few weeks of the injury with pain and much stiffness and limitation of movement. A swelling becomes palpable in the soft tissues in front of the elbow of bony hardness, fixed to the surrounding tissues, but not attached to the humerus. X ray examination shows the new bone in the muscle in front of the lower end of humerus. The diagnosis is to be made from bone sarcoma.

The treatment is to keep the limb at rest in a sling with the elbow well flexed All active movement should be stopped, and massage and passive movement forbidden. Under proper treatment the new bone tends to be absorbed gradually The progress may be followed by radiography and if after several months a plaque still remains, it may be excised. *Premature operation, however is apt to be followed* by recurrence

Tennis Elbow

This troublesome affection is not confined to tennis players, but also occurs in other athletes, sportsmen and manual workers

The pain is sometimes severe and incapacitating and very resistant to treatment. Generally the pain is referred to a point over the radio-humeral joint, deep to the common extensor origin about ½ inch below the lateral epicondyle, and from this point it may radiate towards the wrist. Less often the pain is on the medial side of the elbow or near the origin of pronator teres It can be reproduced by forcible resistance to hypertension of the wrist.

Accompanying the pain is a sense of weakness of the wrist and hand sometimes impairing the grip so that objects held in the hand are dropped.

On examination the passive movements of the elbow are free, but there is a small area of extreme tenderness at the site of the lesion

Causation. There has been much theorising upon the cause of tennis elbow Probably in most cases there is a strain of the common extensor origin, with tearing of some of the muscle fibres and elevation of the attached periosteum. In some cases a strain of the radio-humeral joint may be responsible, while in yet others the cause may be a traumatic inflammation of a small adventitious bursa under the common extensor origin.

Treatment. (1) In acute cases with much pain and tenderness novocain injection may bring prompt relief. If this fails, the elbow should be strapped The elbow is partly flexed and three-quarters supinated and enveloped in an adhesive elastic bandage, the lateral epicondyle being protected by a small disc of felt with a central hole. Tennis should be forbidden for at least a month.

(2) In recurrent cases 5 ml of 2 per cent. procain with 1,000 units of hyaluronidase may be injected at the site of pain on one or two occasions. Recently 5 ml. of a solution containing 25 mg hydrocortisone has been recommended instead

OLECRANON BURSITIS

The subcutaneous bursa situated over the superficial surface of the olecranon is liable to traumatic and to septic inflammation Traumatic olecranon bursitis (miner s or student's bursitis) results from repeated or intermittent pressure. The bursa becomes distended with watery fluid, and the overlying skin is tense and shiny Pain is variable. The treatment is to protect the bursa from pressure and to apply counter irritants. If these measures fail, the bursa may be excised along with the underlying spur of bone which is often present.

Infective olecranon bursitis is generally a complication of cellulitis of the forearm, for the bursa is in direct communication with the lymphatics of this region. There is a localised, inflamed and very tender swelling over the point of the elbow It may respond to penicillin otherwise the treatment is to incise the abscess and evacuate the pus.

CHAPTER 18

THE FOREARM, WRIST, AND HAND

Examination

INSPECTION should first be carried out, and the general contour and appearance of the region noted and compared with the normal side.

Palpation is then undertaken. The whole length of the subcutaneous border of the ulna and the lower half of the radius are felt. The styloid processes are compared, the radial styloid, which is palpable in the 'anatomical snuff box,' *normally lies ½ inch distal to the ulnar styloid*. The scaphoid, lying in the floor of the "anatomical snuff box," is felt when the hand is deviated towards the ulnar side. The metacarpals and phalanges are palpated. Finally, the movements of the wrist, hand and fingers are tested.

INJURIES

Fractures of the Forearm Bones

The ulna and radius may be fractured separately, but much more commonly both bones are fractured together.

Fracture of the shaft of the ulna may be caused by a direct blow or by angulation. The line of fracture is transverse and the displacement variable. *All the signs of fracture are present and as the whole length* of the ulna is subcutaneous, the diagnosis is easy.

A fracture in the upper third may be accompanied by dislocation of the head of the radius (Monteggia fracture). Usually there is forward angulation at the site of fracture with anterior dislocation of the radius. In this type it is necessary to plate the fracture, reduce the dislocation and immobilise with the elbow flexed.

Fracture of the shaft of the radius may occur at any level. One common site is at the lower third of the bone, resulting from backfire accidents (chauffeur's fracture). In children, fracture of the radius is often of the greenstick variety.

Reduction is obtained by manual traction and a plaster slab applied. If the fracture is in the upper third the small proximal fragment will be flexed and supinated, so the limb must be held *with the elbow bent and* the forearm supinated to suit, otherwise the forearm is held in mid pronation.

Fracture of both bones of the forearm may result from a direct blow or a fall on the hand. In the former case the fractures are transverse and at the same level; in the latter they are oblique, and the ulna is generally broken at a higher level than the radius.

The displacement varies according to the direction of the force. As a rule the radius tends to be displaced in the way described above.

The important feature, however, is that the ends of the four fragments tend to fall in towards each other, and may unite with a bony bridge across the interosseous space, which entirely eliminates pronation supination and causes much disability The treatment is to fix the fragments by screw plates.

Colles' Fracture

The important fractures in the region of the wrist are the Colles' fracture, the "reversed Colles'" or Smith's fracture and separation of the distal radial epiphysis.

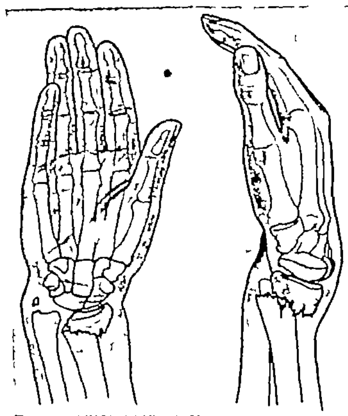


Fig. 71 Colles fracture.

Colles fracture is one of the commonest fractures in the body It is especially frequent in elderly women.

The fracture results from a fall on the outstretched pronated hand The line of fracture passes through the broad part of the radius, ½ inch or so from its lower end. Often the tip of the ulnar styloid process is also torn off.

The displacement can readily be understood by considering how the fracture is sustained The force of the blow is transmitted from the point of impact, the ball of the thumb backwards and proximally through the carpus to the lower end of the radius. The small distal fragment is therefore displaced backwards and at the same time rotated

backwards. It is also forced laterally and proximally and impacted against the sharp posterior edge of the proximal fragment. In this way the radial styloid comes to lie at the same level as the ulnar styloid or even higher In addition, the small distal fragment is rotated slightly round a sagittal axis, carrying the carpus and the hand into a *position of radial deviation.*

The deformity is characteristic. The small fragment forms a prominence on the dorsum of the wrist, whilst the lower end of the proximal fragment projects forwards and replaces the normal concavity at the front of the lower end of the radius. The hand is displaced backwards with the small fragment, and the contour of the whole wrist region when viewed from the side, presents a ' dinner fork " *deformity The hand is also deviated to the radial side, and the lower* end of the ulna is thereby rendered prominent. The region of the fracture is swollen and painful. Extension of the fingers is limited. In a few cases there are motor and sensory disturbances due to pressure on the median nerve.

A fracture of one of the carpal bones sometimes co-exists, and for this reason as well as for routine considerations radiography should always be advised



FIG. 72. Reduction of Colles fracture.

Treatment. The fracture may be reduced under general or local anaesthesia. Failure to effect proper reduction leaves a very unsightly deformity difficult to hide. To reduce the fracture the surgeon grips the affected wrist between the balls of his thumbs, the one in front, the other behind If the right wrist is involved, the surgeon grips it

with the ball of his right thumb in front, the ball of his left thumb behind

First the fracture is disimpacted by firm traction The grip is then shifted slightly so that the lower fragment is gripped between the balls of the thumbs. The lower fragment is then forced distally and forwards into its proper position and at the same time the radial deviation of the hand is over-corrected. Reduction may be judged complete when the general contour of the wrist regains its normal appearance, the radial deviation of the hand is lost, and the styloid processes are restored to their proper relationship Reduction must always be checked by radiography



FIG. 73. Treatment of Colles fracture by unpadded dorsal plaster splint.

After reduction the fracture must be immobilised on a splint. For this there is nothing better than a dorsal unpadded plaster shell, which is easy to apply efficient and far preferable to the older types of splint, which do not fit the individual case. A single 6-inch plaster of Paris bandage is soaked in water and then folded on a flat table to form a slab 6 inches wide and 12 inches long Whilst still moist this splint is applied directly to the skin on the dorsum of the forearm, from the knuckles to just below the elbow and is moulded to the part and fixed by a gauze bandage, the wrist being kept flexed and in ulnar deviation. The fingers and thumb must be left free. The forearm is supported in a sling Subsequently the position of the fragments must be checked by radiography with special attention to the lie of the articular surface which should be tilted 20 degrees forwards. On the following day or when any swelling has subsided, a circular plaster bandage is applied over the gauze bandage.

The after treatment is to encourage purposeful movement of the thumb and fingers from the start. The sling is discarded after a week and the plaster is removed after five weeks. No massage is required Complete recovery of function is to be expected in two months or less.

Smith's Fracture (*Reversed Colles'*) This fracture results from a fall on the fully flexed hand The line of fracture is at the same level as a Colles

fracture, but the deformity is reversed, for the small distal fragment is driven forwards by the force of the impact.

The treatment is on the same lines as for Colles fracture and the prognosis is similar

Separation of the Distal Radial Epiphysis. This injury occurs between the ages of 7 and 17 as a result of the same type of accident that causes a Colles or Smith's fracture. The displacement is similar and the diagnosis is based on the age incidence and on the results of radiography The treatment is carried out on similar lines

Sprain of the Wrist. This injury may result from a fall on the hand or a sudden twist or jerk. It must be emphasised however that a sprained wrist often *masks a fractured scaphoid.* Radiography should therefore always be carried out.

Fracture of the Carpal Scaphoid

This injury may result from a lengthwise blow on the point of the knuckles of the index or middle finger But it may follow quite minor



FIG. 74. Fracture of scaphoid.

occupational stresses so it is very apt to be missed or to be regarded as a simple strain

The fracture is a simple fissure across the waist of the bone, and there is no displacement unless, as occasionally happens, the lunate is dislocated too In such cases the proximal fragment is displaced with the lunate.

The clinical features are characteristic. Pain is felt in the region of the scaphoid, and there may be swelling in the 'anatomical snuffbox" and on the adjacent part of the dorsum of the carpus. The movements of the wrist are impaired Tenderness can be elicited by direct pressure on the scaphoid in the snuff box, or indirectly by forcing the hand

into radial deviation or by percussing on the first, second or third knuckle.

Radiography should always be carried out and if necessary repeated in a few weeks time as the fracture line may not be immediately visible.

Treatment. The wrist must be completely immobilised for several weeks in an unpadded plaster cast. First a dorsal plaster splint is applied as for Colles fracture, with the wrist slightly dorsiflexed. The plaster is moulded firmly in position and fixed by a circular plaster bandage, which is applied with care so as to immobilise the carpus and the base of the thumb but leaving the fingers free. The plaster is left in position for six weeks, and if radiography then shows no sign of union, another is applied if necessary for three or four months.

Non-union. Owing to the scanty blood supply a fracture of the scaphoid is notoriously liable to non union even if carefully treated and in some cases the proximal fragment may undergo necrosis.

The treatment in early cases is to immobilise the carpus completely for from three to six months. In later cases, or where immobilisation fails, the scaphoid should be exposed and drill holes made across the line of the fracture to vascularise the sclerosed bone. Some surgeons prefer to make a single drill hole through the two fragments and to insert a bone-graft.

Dislocation of the Lunate

This injury follows a sudden forcible dorsiflexion of the wrist. There is a momentary dorsal dislocation of the whole carpus with the exception of the lunate, which is held in position anchored to the front of the

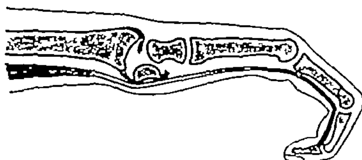


FIG. 75. Dislocation of the lunate (after Böhler). The lunate is displaced forwards and comes to lie deep to the flexor tendons in front of the wrist. Being anchored to the radius by the anterior radio-lunate ligament, it is generally rotated as shown.

radius by the powerful anterior radio-lunate ligament. When the carpus rebounds into place the lunate is dislocated forwards and comes to lie deep to the flexor tendons. As the anterior radio-lunate ligament generally still remains intact, the lunate is rotated so that its *distal* semilunar surface comes to face anteriorly.

The displaced bone gives rise to a swelling in front of the wrist, deep to the flexor tendons. There is considerable pain, the fingers cannot

be fully extended and dorsiflexion at the wrist is impaired. Often there are signs of pressure on the median nerve.

The diagnosis is confirmed by a lateral radiograph.

The treatment is to reduce the dislocation under general anæsthesia. The first essential is to open up the space normally occupied by the lunate by exerting prolonged, powerful traction on the hand. Sometimes this alone suffices and the lunate slips back into place. If not, it may be pressed into place while the wrist is slowly flexed. If this fails, skeletal traction should be applied by a pin through the metacarpal heads. After reduction a dorsal unpadded plaster splint is applied, as for a Colles' fracture (p. 151), and left in position for three weeks. Rarely operation is required, to replace the bone or remove it.

Wounds of the Hand and Fingers

A wound of the hand or fingers may result in much disablement and serious economic loss, particularly to the manual labourer Such injuries, therefore, have a clinical importance out of all proportion to their extent and danger In treating them, attention should be paid to the following main principles —

(1) Apart from quite trivial lesions, the injury should be given as much thought, time and attention as a major operation. A wound involving a cut tendon or nerve may well demand two or three hours expert care in a fully equipped operation theatre.

(2) Before operation the extent of the injury must be assessed, bearing in mind the possibility of tendon injury nerve damage, and fracture. A lesion of the median nerve or a digital nerve is particularly apt to be missed

(3) General anæsthesia is often desirable, though in some cases a regional or brachial plexus block may be indicated.

(4) A tourniquet should be used, either an inflatable cuff or a light Esmarch s rubber bandage

(5) After thorough cleansing the wound must be thoroughly explored and if necessary enlarged to assess the full extent of the injury

(6) After repairing any damage, one should always aim to close the wound. In some cases a free split-skin graft may be needed. After gross injuries with much tissue loss, a pedicle graft may be taken from the abdomen.

(7) The limb should be immobilised on a high splint or plaster slab for a period which may extend to three weeks. Movement of the joints is attained most completely after the soft tissues have healed soundly

Amputating Injured Digits. When part of a digit is hopelessly damaged, the merits of removing the damaged part, or of a clean amputation at a higher level, must be considered.

Thumb The lack of a thumb against which the fingers can be opposed is as great a disability as lack of all the other fingers combined No portion of the thumb should be sacrificed if there is a hope of its survival. In severe injuries when loss of mobility is to be feared, the

thumb should be immobilised in optimum position (e g as for holding a glass) so that the fingers may be freely opposed to it in grasping

Fingers Stiffness of the terminal joint causes little disability When the terminal phalanx is lost, an amputation at the terminal joint gives a good result. If part of the middle phalanx must be sacrificed, as much of it as possible should be preserved since flexor and extensor tendons are both attached to it even the base of the phalanx alone is worth preserving unless the proximal interphalangeal joint is damaged and likely to be stiff Amputation at the proximal interphalangeal joint is not advisable, for the proximal phalanx is of little value since its movements cannot be controlled In the case of the middle and ring fingers, it is better to amputate at the M P joint. In the case of the index and little fingers, since the stump of a metacarpal head is an annoying excrescence, it is better to amputate through the shaft of the metacarpal bone which gives a good result from the point of view both of appearance and function

Cut Tendons. This common injury generally results from a cut with a knife or a sharp fragment of glass. It constitutes a very disabling injury which often gives rise to permanent impairment of function Even if the tendon is sutured at once and heals promptly some stiffness persists for several weeks, while the occurrence of sepsis may leave permanent stiffness.

The flexor tendons may be divided in the finger or in the palm or at the wrist. In deciding which tendon is cut, it must be remembered that the long flexor tendon flexes the distal joint of the finger the short tendon flexes the middle joint, while the proximal joint is flexed by the lumbrical muscle. The possibility of coincident injury to the median or ulnar nerves or a digital nerve must be borne in mind

In the emergency treatment of a wound involving injury to tendons the best plan is simply to cleanse the wound thoroughly and apply skin sutures.

Two weeks later when the wound is healed and the possibility of sepsis is eliminated, a clean formal operation is performed for the repair of tendons (and nerves)

At this second stage the area is exposed by suitable incisions and the tendons are identified

In the finger the profundus tendon is the one most commonly involved. If it is sutured in the ordinary way it is very liable to become fixed by adhesions within the narrow rigid sheath. Some surgeons therefore remove the sheath so that the tendon comes to lie in the subcutaneous tissues at the level of suture. An alternative method is to excise the whole length of the tendon from within the palm down to the distal phalanx, and replace it by a graft such as the palmaris longus tendon.

In the palm or at the wrist if more than one tendon is cut, the main problem is to avoid cross union and since the profundus tendon is much more important than the sublimis the treatment is modified accordingly Thus, if the profundus alone is cut it is repaired if the sublimis alone

is cut it is left untreated if both are cut the profundus is repaired while the ends of sublimis are removed.

In suturing a tendon the finest waxed silk (4/0) is used the stitch being inserted as indicated in Fig 76 Subsequently the part must be immobilised for at least three weeks, as *tendons are slow to heal.*

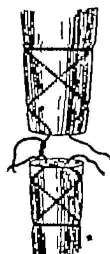


FIG. 76. Tendon suture.

Subungual Hæmatoma. This results from a blow on the nail or a momentary crush. The extravasated blood presses on the tender nail bed, and causes severe pain. Immediate relief follows decompression of the hæmatoma by inserting a needle or narrow bladed scalpel from the free edge of the nail. If the hæmatoma is extensive, the old nail is displaced as the new one grows. Initial removal of the nail needlessly exposes the nail bed, and is to be avoided.

Crush of the Terminal Phalanx. This is one of the commonest injuries. The nail is often partially detached, and should generally be removed Any tags of flesh or fragments of bone are excised. The finger is encased in plaster of Paris for a fortnight, the patient being instructed to remove the plaster if there is any feeling of tension. Work can often be resumed at once.

Slicing Injuries. These injuries, as from ham slicing machines, are best treated by an immediate split-skin graft.

Human Bites. Injuries against an opponent's teeth may be sustained in brawls. Even a small lesion leads to a low-grade but persistent infection, and the wound should therefore be carefully excised.

Puncture Wounds with Indelible Pencils. The colouring matter is methyl violet which in concentrated solution is a protoplasmic poison When the point of the pencil breaks off in the wound the surrounding tissue undergoes necrosis, and for this reason a block of tissue including the point should be excised as soon as possible. No attempt should be made to pick out the point with forceps, as this further diffuses the dye.

Fracture of the Finger Metacarpals

A metacarpal bone may be fractured by direct violence, or indirectly by a blow on the knuckle, e.g in boxing The fracture may be situated close to the neck or in the shaft of the bone. There is severe pain at the time of injury and tenderness may be elicited by pressure over the fracture or in the long axis of the finger Crepitus may be elicited.

In the case of a fracture of the shaft there is generally little deformity The most satisfactory treatment is to apply a short posterior plaster slab, fixing the hand to it by adhesive strapping Fixation should be maintained for three or four weeks.

In the case of a fracture of the neck of the bone there is often an angular deformity This should be reduced by flexing the finger to a right angle and then pushing it dorsally While the pressure is maintained a dorsal plaster slab is then applied to the wrist and hand and

affected finger The remaining fingers must be left free and exercised frequently

Bennett's Fracture of the Base of the Thumb Metacarpal

This common fracture or fracture-dislocation is one form of a "stave of the thumb" It results from a blow on the knuckle or the point of the thumb driving the base of the metacarpal against the multangulum majus. The fracture is an oblique one. The small proximal fragment, which includes most of the palmar part of the articular surface, remains in its normal position while the large distal

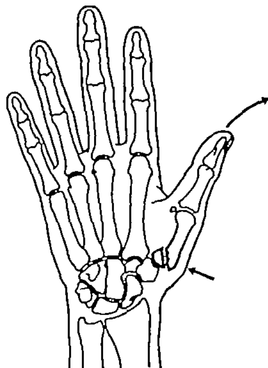


FIG. 77 Bennett's fracture. The arrows indicate the manipulation for reducing the displacement. (After Böhler)

fragment, i.e. the shaft of the metacarpal, is displaced proximally and backwards, forming a prominence in the "anatomical snuff box."

There is much pain, with stiffness of the thumb. In untreated cases the disability is considerable.

The treatment is to reduce the displacement under general anaesthesia. The thumb is well abducted and traction is exerted upon it, while the displaced base is pressed directly into position The displacement is easily reduced, but tends to recur Fixation may be obtained by a plaster of Paris splint extending from the forearm to the knuckles and accurately moulded round the thumb which is held in the position for gripping a glass. Often it is necessary to apply traction either by skin tapes or by a fine wire inserted through the pulp A strong wire hook incorporated in the plaster serves to take the traction tapes.

Fracture of the Phalanges

Fracture of the phalanges generally results from a crush accident, and, owing to the superficial position of the bones, is usually compound. In most cases the fracture is obvious, but if there is much swelling and little displacement it may escape recognition.

The treatment in a simple fracture is to reduce the displacement and immobilise the finger along with its neighbour for two or three weeks with all the joints partly flexed A bent aluminium splint may be used, or a moulded plaster splint.

Hey's Dislocation of the Thumb Metacarpo-phalangeal Joint

In this injury due to forcible dorsiflexion of the thumb, the base of the first phalanx is displaced on to the dorsal aspect of the head of the

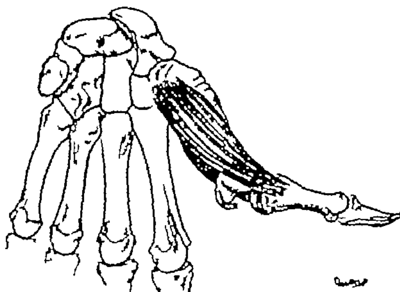


FIG. 78. Hey's dislocation.

metacarpal bone The volar ligament of the joint is torn from the metacarpal, but remains attached to the phalanx and is displaced with it. It may become interposed between the two bones and impede reduction.

The tendons attached to the base of the phalanx (the two heads of the flexor pollicis brevis with the adductor and abductor pollicis and the two sesamoids in their common tendons) are also carried backwards and may become entangled round the metacarpal head, causing further difficulty in reduction

The treatment is to reduce the dislocation under general anaesthesia. The phalanx is first acutely dorsiflexed, increasing the deformity and the base of the bone is then levered into position. Reduction is best carried out with the metacarpal opposed towards the little finger as far as possible. If manipulation fails, a tenotomy knife should be inserted from the dorsal aspect so as to divide the displaced anterior

ligament longitudinally The two halves then retract to either side and permit reduction

Stenosing Tendo-vaginitis at the Radial Styloid

This condition affects the sheath of the long abductor and short extensor tendons of the thumb at the point where they cross the lower end of the radius to form the anterior margin of the " anatomical snuff box." The sheath at this point becomes inflamed and thickened and a fibrous stenosis develops, which interferes with the smooth movement of the tendons.

The disease is generally due to occupational strain, and occurs mainly in manual labourers and in washerwomen

There is pain in the region of the radial styloid process. The movements of the thumb are impaired, especially abduction and extension, and attempts to perform these movements aggravate the pain. The " anatomical snuff-box " is partly obscured by œdema, and the thickening of the tendon sheath may be palpable.

The treatment in acute cases is to immobilise the wrist in plaster of Paris for a month. In chronic cases the sheath should be exposed under local anæsthesia and the thickened segment incised. Immediate relief is to be expected.

Trigger Finger

This affection results from a localised stenosing tendo-vaginitis affecting the sheath of the long flexor tendon of one of the fingers, especially the middle finger A localised disparity between the tendon and its sheath results, and the movements of the tendon become jerky, so that the finger is suddenly arrested and then released with a snap.

The treatment in early cases is to keep the finger warm and at rest, so that the inflammation may subside. In later cases the stenosed sheath should be exposed and the thickened segment either incised or excised

Mallet Finger

In this deformity the terminal phalanx of one of the fingers is fully flexed and partially or completely powerless. The condition is due to rupture of the insertion of the long extensor tendon into the base of the distal phalanx, or more often, to avulsion of the portion of bone to which the tendon is attached. The injury is caused by sudden forcible flexion of the terminal phalanx when hit, for example, by a cricket ball or baseball.

The treatment is to roll a strip of plaster bandage into a tube rather longer than the finger and just wide enough to accommodate it. The proximal end is cut obliquely to fit over the web of the finger as far as the

knuckle. The finger is then dipped momentarily in warm water and the wet plaster cylinder is moulded firmly to the skin. Now the patient is instructed to press with his thumb against the finger tip so as to hyperextend the terminal phalanx, and this position is maintained until the plaster sets. The plaster is left in place for five to six weeks. Full movement may be obtained as soon as the plaster is removed or after a further period of three to four weeks.

If this method fails, operative treatment is indicated The torn tendon is sutured and the finger again immobilised in plaster

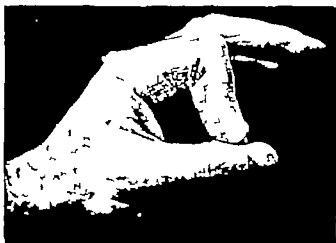


Fig. 79 Treatment of mallet finger The gauze represents a cylinder of plaster bandage.

Rupture of the Long Extensor of the Thumb

This is an interesting affection, in which the tendon of the extensor pollicis longus undergoes "spontaneous rupture at the level of the wrist. It is seen in kettle-drum players, or it may follow some weeks after a fracture of the radius. It is thought to be an end result of gradual atrophy of the tendon, associated with traumatic inflammation of the tendon sheath.

The distal part of the tendon adheres to its sheath, and consequently the tip of the thumb does not usually become flexed, but the power of extending the terminal phalanx is lost. The most satisfactory treatment is to suture the distal end of the tendon to the extensor indicis.

Dupuytren's Contracture

This deformity is seen most often in middle-aged or elderly men and may be familial.

It is an affection of the palmar fascia, which becomes thickened and fibrous, and by contracting leads to progressive flexion of the little and ring fingers. The disease first appears as a nodular thickening in the palm in the line of one or other of these fingers. Later a contracted cord of tissue becomes evident, which draws up a fold of skin and pulls

upon the corresponding finger In most cases both the ring and little fingers are involved, but the middle and index fingers remain unaffected The two proximal joints of the fingers become acutely flexed and immobile, while the terminal joint becomes hyperextended. The joint capsules become contracted secondarily



Fig 80 Dupuytren's contracture.

The diagnosis is to be made from congenital contracture which is nearly always limited to the finger usually the little finger, and does not affect the palm or the metacarpo-phalangeal joint. Contracture due to injury or to a septic hand must also be considered. There is rarely any difficulty in the diagnosis.

If treatment is required, the contracted bands may be divided by multiple subcutaneous fasciotomy but a better method is to dissect out the whole of the affected fascia and remove it. This is done through a transverse incision along the distal palmar crease, to which may be added a Z incision near the base of the affected fingers. Post-operative exercises and splintage must be continued for a long time.

In disabling contracture of the little finger amputation may be advised.

Carpal Tunnel Syndrome

In this condition the median nerve is compressed by oedema as it lies within the carpal tunnel. The nerve compression leads to tingling and partial anaesthesia and some muscle atrophy in the median nerve distribution in the hand and also to reflex pains in the forearm, elbow

and shoulder regions These later lead to confusion with symptoms from cervical spondylosis, cervical rib, "neuritis," "fibrositis" and other similar diagnoses. In most cases the symptoms abate if the wrist is put at rest in a light plaster splint. If this fails, the treatment is to decompress the nerve by incising the transverse carpal ligament.



FIG. 61 Web fingers.

Syndactylism Webbing of the fingers is a rare congenital deformity Two or more fingers may be involved and frequently the disease is bilateral. The fingers may be united by a thin broad web or they may be closely fused together *The thumb is very rarely involved.*

Treatment should be postponed until the child is six or eight years old. If the web is tenuous it may be incised midway between the fingers, and the linear wounds sutured. If the union between the fingers is more intimate, an extensive plastic procedure is necessary The raw surfaces on the contiguous sides of the digits are easily covered either by skin flaps or better by Thiersch grafts The main difficulty is to provide a flexible web at the proximal end of the interdigital space. This is best achieved by turning in a rectangular skin flap from the dorsal aspect.

INFECTIONS OF THE FINGERS AND HAND—WHITLOWS

Infections of the fingers and hand often follow a trivial injury but may lead to grave disability and may even threaten life. They demand prompt recognition and early efficient treatment.

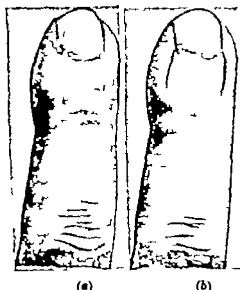
Purulent Blister

This is a superficial infection in which pus collects between the layers of the epidermis, and elevates the thick horny layer as a blister It is common in manual labourers, is generally due to infection carried in by embedded foreign particles or splinters, and consequently is generally situated on the palmar aspect of the fingers or hand. The purulent blister must be diagnosed from a deeper infection spreading to the surface. Generally it gives rise to little pain and little constitutional reaction, and the diagnosis presents no difficulty

Treatment. Remove the thick horny covering of the blister Usually this can be done without anæsthesia, using sharp-pointed scissors or a razor Healing occurs rapidly

Nailfold Infections—Paronychia

This common infection under the nailfold is seen most often in nurses and others who handle septic material It may come on acutely or may follow a chronic course. In chronic cases tuberculous infection should be suspected In acute cases, the skin at one side of the nailfold becomes swollen congested and painful There may be some tender



(a) (b)

FIG. 82. (a) Paronychia occurring in a nurse as a result of contact with septic material. (b) Paronychia, showing the incisions advised.

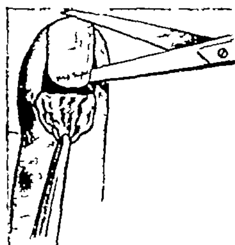


FIG 83. Paronychia. The skin flap has been retracted, revealing the base of the nail elevated by a collection of pus deep to it. Scissors inserted to remove the elevated nail base.

enlargement of an axillary gland, the temperature is raised a point or two and there is considerable malaise. Later a yellow spot appears in the centre of the affected part, while the swelling may spread along the whole length of the nailfold and pus may track deep to the base of the nail. In chronic cases the pain and swelling are much less evident, and the main feature is chronic discharge from under the nailfold.

Treatment. In mild cases it sometimes suffices to apply Elastoplast sufficient to cover the whole finger If no increase of pain is noted the dressing is left in position for a week, and, if necessary replaced by a fresh one for a similar period. An antibiotic may be given.

In more severe cases operative treatment should be carried out under general anæsthesia. A rubber catheter is tied round the base of the finger to act as a tourniquet. Incisions are then made as shown in Fig 82 (b), keeping them well to the side to avoid damage to the nail bed. The rectangular flap of skin at the base of the nail is then elevated and turned back. The base of the nail is then examined, and if it is found

to be undermined by pus, the part of the nail separated from its bed is removed with scissors. A strip of gauze soaked in penicillin cream is then packed into the cavity so as to keep the skin flap well retracted and the whole covered by an adhesive bandage and left untouched for several days. The wound should heal in from ten to fourteen days. A new nail grows in two or three months, displacing what remains of the old one in front of it.

Streptococcal Lymphangitis

This is the most dangerous form of septic hand. It is generally due to hæmolytic streptococci which gain access through a wound or abrasion, spread quickly along the lymphatics of the hand and arm to the regional glands, and sometimes reach the blood stream and cause septicæmia.

Streptococcal lymphangitis was common as a result of small punctured wounds of the hand or fingers e.g by a splinter or rusty nail. The most virulent cases resulted from needle pricks sustained in the autopsy room, or when operating upon cases of hæmolytic streptococcal infections. There are many cases on record of death from septicæmia within a few days of such an apparently trivial injury.

The onset of the disease is acute, sometimes within a few hours of the initial injury. The temperature mounts rapidly perhaps to 103 F or higher there is marked malaise, and often there are repeated rigors. In a severe case delirium occurs early and toxæmia is profound.

On examination, the hand and arm are swollen and inflamed. The affected finger is intensely congested and, spreading from it along the dorsum of the hand and thence to the forearm and arm, there is a leash of inflamed lymphatics, which can be seen and even felt. The skin over these lymphatics presents a scarlet flush and is exquisitely tender.

The axillary glands become enlarged at an early stage, and are very tender. The epitrochlear gland may also be inflamed.

The initial wound or finger prick may show signs of suppuration, but more often presents no untoward appearance, and may indeed be difficult to find.

Treatment. Penicillin offers effective treatment for what was formerly a dangerous infection. The drug is given intramuscularly in full doses until the infection is controlled. The limb is immobilised on a splint and elevated, and heat applied by fomentations or an electric cage. If an abscess develops it should be incised.

Pulp Infection of the Finger

Infection of the finger pulp generally results from a prick with a pin, splinter or nail, and its especial importance arises from the anatomical disposition of the tissues in the pulp. The skin in this region is bound down to the periosteum of the terminal phalanx by bands of fibrous tissue which divide the subcutaneous fat into small lobules enclosed in separate compartments. Consequently pus forming in this region is held under tension, causes much pain and leads to

sloughing of the fatty tissue It may, moreover, infect the terminal phalanx, leading to decalcification and, rarely, to the formation of a sequestrum. Fortunately the distal joint is not involved

The diagnosis of a pulp infection is not difficult. At first there is a sense of tightness in the finger tip with tenderness on deep pressure. Later the pain increases and assumes a throbbing character There is a



Fig. 84. Pulp infection of finger Note sodden state of tissues due to use of wet dressings.



Fig. 85. Pulp infection of finger The terminal phalanx is decalcified, and a small cavity is just visible within it.



Fig. 86. Incision for pulp infection of finger

variable degree of constitutional disturbance. The finger tip is swollen, bulbous and inflamed.

Treatment. In recent years the treatment of pulp infections has changed completely Formerly early operation was advised, with wide through and through drainage of the pulp or even an incision across

the finger tip Now with penicillin, operation is delayed till the abscess is ready to point, and the incision is made directly over this site.

In the first place, give penicillin in full doses, immobilise the hand on a splint with the fingers padded with wool, elevate and apply heat by an electric bulb In due course the abscess will point in the middle line on the volar aspect of the pulp A small transverse incision is made at this site. After incision, a vaseline dressing is applied. Rapid healing can be expected, with complete restoration of function.

Tendon-sheath Infections (*Tenosynovitis Tendo-vaginitis Thecal Whitlow*)

These infections are rare. In the past, their importance has been exaggerated by unnecessary attention to the anatomical complexities of the part. It is sufficient to note that the following tendon sheaths are present (Fig 87)

The flexor sheath of the thumb surrounds the tendon of the flexor pollicis longus, and extends from the base of the terminal phalanx of the thumb up into the palm. There it is continuous with the *radial bursa*, which, enclosing the same tendon, passes up under cover of the transverse carpal ligament as far as the proximal skin crease at the wrist.

The flexor sheath of the little finger surrounds the profundus and sublimis tendons, and extends from the base of the terminal phalanx of the little finger up into the palm. There it is continuous with the *ulnar bursa*, which encloses the flexor tendons of all the fingers and passes up under cover of the transverse carpal ligament. In 50 per cent. of cases the radial and ulnar bursæ communicate.

The flexor sheaths of the index, middle and ring fingers are generally limited to the fingers, and terminate proximally at the level of the distal palmar skin crease. In some cases, however they communicate with the ulnar bursa.

A tendon sheath infection is a disabling disease, for it is very apt to cause adhesions between the tendon and its sheath, or even to lead to sloughing of the tendon. Consequently stiffness of the fingers and hand is a common sequel. In neglected cases the infection may open into and destroy the joints, especially the first interphalangeal joint, or it may spread to the deep palmar space or to the forearm and lead to prolonged suppuration.

The infection generally follows a finger prick, especially a prick in the skin crease in front of the first interphalangeal joint, where the sheath lies close to the skin. If the index, middle or ring finger is involved, the infection may remain limited to the finger but in the case of the thumb or little finger it generally spreads widely, involving the radial or ulnar bursa in the palm, and often extends under the transverse carpal ligament to the wrist.

The affected finger is held immobile, slightly flexed. It is greatly swollen, both on the palmar aspect and on the dorsum. Attempts to straighten the finger actively or passively cause much pain and there is great tenderness on pressure over the sheath.

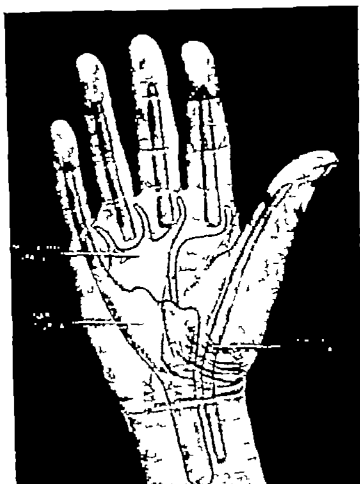


Fig. 87 Flexor tendon sheaths and deep palmar spaces of the hand.

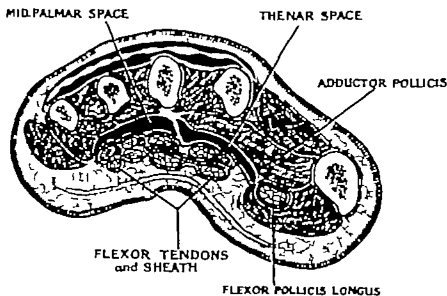


Fig. 88 Flexor sheaths and deep spaces of the hand.

In the palm the dense palmar fascia limits swelling, but, despite this, the normal hollowing is lost, and there is some fullness over the affected bursa. Often there is considerable swelling proximal to the transverse carpal ligament.



FIG 89 Tendon sheath infection of the ring finger secondary to the wound seen at the base of the finger The ulnar bursa communicated with the digital flexor sheath and was also involved. Note the swelling of finger and palm, and the characteristic flexion of the fingers. Attempts to straighten the affected finger caused severe pain.



FIG. 90. Infection of index flexor sheath and palm, treated by early incision, fomentations and baths. Note the unhealthy sodden condition of the skin.

Treatment. The treatment of tendon sheath infections has been revolutionised by the introduction of antibiotics and by a better understanding of the needs of inflamed tissues Formerly it was necessary to make wide incisions as soon as possible, and thereafter it was the practice to soak the limb in fomentations, poultices or saline baths. As a result the tissues became swollen and sodden, and healing was much delayed

The modern plan is to treat the infection primarily by antibiotics and conservative measures. This nearly always arrests the progress of the disease and may abort it. If the infection persists and goes on to the

formation of an abscess it is necessary to make an incision, but this should be delayed until the abscess is 'ripe.'

Penicillin is generally suitable as an antibiotic, unless the organism is known to be resistant. The local treatment is to envelop the arm in a wool dressing to immobilise it on a light splint, and to elevate it in a sling or on a pillow Dry heat may be applied by means of an electric lamp or other form of heater

If it is necessary to open an abscess, a small incision is made over the most prominent part. The extensive "anatomical" incisions of former years are now obsolete. The most suitable sites for incision are indicated in Fig 91

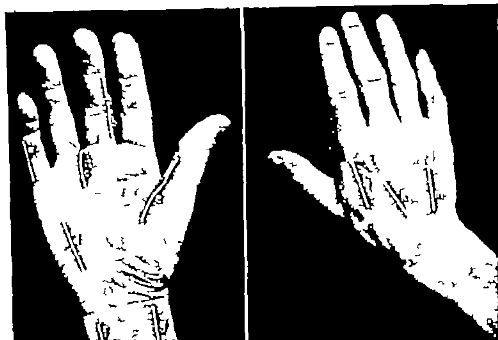


FIG. 91 Incisions for hand suppurations. (*a*) and (*b*) Flexor sheaths of fingers. (*c*) Middle palmar space. (*d*) Ulnar bursa. (*e*) Radial bursa. (*f*) and (*g*) Deep forearm spaces. (*h*) Thenar space. (*k*) and (*m*) Dorsal subaponeurotic spaces. Note that it is now rarely necessary to make such extensive incisions, while the site of the incision is now determined more by the ripening abscess than by anatomical considerations.

After treatment. Formerly the after treatment was to soak the hand in hot boric baths for periods of half an hour every two hours, and in the intervals to apply hot boric fomentations. Active and passive movements were encouraged with the object of minimising stiffness. This treatment had the disadvantage of rendering the skin soft and sodden, and causing so much œdema as to interfere with drainage. Moreover movement of the tendons might spread the infection to other parts of the sheaths. Most surgeons, therefore, now prefer to apply vaseline dressings, and to immobilise the hand on a splint, with the wrist in dorsiflexion and the fingers almost straight, so as to prevent dislocation of the exposed tendons from their sheaths. The hand is

elevated, to relieve pain, and kept warm in a heat cage. Penicillin is continued for several days. When the infection abates, active movement of the fingers is encouraged.

Prognosis. The end results depend on the extent of the infection and on the promptness and thoroughness of treatment. Even in the most favourable cases there will be stiffness of the finger for several weeks, whilst in more severe cases there will be prolonged stiffness and permanent disability, especially if a tendon sloughs. Subsequently amputation of a finger may prove advisable, for a stiff finger is of little use and may be a source of annoyance, especially in a manual labourer A thumb, however stiff, should not be amputated.

Infection of the Deep Palmar Spaces

Two potential spaces lie deep in the palm, the *middle palmar space,* which lies deep to the flexor tendons of the medial three fingers, and the *thenar space* which lies between the index tendons and the adductor



Fig. 92. Thenar space infection due to a punctured wound.

pollicis muscle. These spaces are involved, rarely by spread of infection from the corresponding tendon sheath, or rarely from a punctured wound. The treatment in the first place is on conservative lines, with penicillin, immobilisation, elevation and dry heat. If the abscess comes to a head it is opened through a suitable incision (Fig 92)

TUMOURS AND CYSTS OF THE HAND

Ganglion

This is a common cystic swelling, which consists of a thin wall of fibrous tissue enclosing a cavity containing colourless jellylike fluid. It forms a smooth, ovoid, painless swelling which can be rendered tense by flexing or extending the wrist. It arises most often in two situations (1) on the dorsal aspect of the wrist close to the tendon of the extensor carpi radialis and (2) on the flexor aspect of the wrist close to the tendon of the flexor radialis. A similar cyst arises on the dorsum of the foot and rarely elsewhere.

The nature of a ganglion is not known. It has been regarded as due to myxomatous degeneration occurring in a tendon sheath or joint

capsule. Usually the ganglion is unattached to the skin and can be separated, though with difficulty, from the tendon sheath. It possesses a deep attachment in the neighbourhood of one of the carpal joints, and unless this deep part is removed, recurrence is common.

The treatment may be conservative or operative An old method which is still practised with a certain amount of success is to burst the cyst by firm finger pressure or by a sharp blow with a well padded hammer Generally, the ganglion should be excised



FIG. 93. Ganglion, in a man aged 50 years.

Xanthoma of Tendon Sheaths This tumour is distinguished by its bright yellow colour which is due to its high content of cholesterol and other lipoids. It is a rare tumour which usually grows from a tendon sheath on the volar aspect of a finger or thumb It forms a firm, nodular painless tumour generally of small size, though occasionally large. Microscopically it has the character of a fibroma, and contains numerous large endothelial and giant cells with a high lipoid content. The treatment is to remove the tumour

Glomus Tumour This is a tumour of one of the cutaneous glomera, the specialised arterio-venous anastomoses which are believed to have the effect of regulating the temperature and controlling the circulation in the neighbouring skin. The glomera are most numerous in the hands, and especially in the nail beds, and the glomus tumour is also commonest in these sites, though it may occur in the subcutaneous tissues in any part of the body The tumour forms a small, firm, smooth nodule, rarely larger than a cherry It may be painless, but when situated under the nail usually causes intense pain. The treatment is to remove the tumour

Implantation Cyst. The volar surface of the hand and fingers is the commonest site for implantation cysts, which occur as a result of injury by a thorn or splinter or needle (see Fig 17) The cyst is removed through a transverse incision.

CHAPTER 10

THE HIP AND THIGH

Examination

THROUGHOUT the examination the affected hip should be compared with its fellow

Inspection. If the patient can walk, the first point is to note the gait, which is quite characteristic in such conditions as congenital dislocation and ankylosis of the hip Next, with the patient stripped and recumbent, the general contour of the hip region is inspected, any fullness or atrophy observed, and the position of the limb noted while at rest. The patient is then turned into the prone position, and any



FIG 94. Thomas' test for flexion deformity of hip. A case of tuberculosis of the right hip in which the deformity is masked by compensatory lordosis. Forcing the sound thigh into full flexion against the abdomen flattens the lumbar spine and demonstrates the full extent of the flexion. Note the tuberculous sinus surrounded by thin, discoloured, undermined skin.

flattening of the subgluteal fold is observed indicative of atrophy of the gluteal muscles.

Thomas' Test. In many diseases of the hip the thigh becomes fixed in flexion and adduction The flexion deformity may be masked by compensatory lordosis of the lumbar spine Thomas test consists in flexing the sound thigh forcibly upon the abdomen with the knee bent, so as to eliminate the lordosis and display the full extent of the flexion deformity

Movements. All the movements at the hip must be tested and compared with the sound side. To eliminate movement at the spinal joints, which would obscure stiffness at the hip the pelvis must be gripped firmly by a hand laid over the anterior superior spine and the iliac crest. Rotation can be estimated accurately with the patient prone, using the leg flexed at right angles as a lever and indicator Then with the patient supine, flexion extension, adduction and abduction are tested in turn.

Mensuration. The bony points suitable for accurate measurements are the anterior superior spine, the tip of the trochanter the adductor tubercle and the medial malleolus. Comparative measurements between these points demonstrate any shortening and indicate the level of the lesion responsible.

Bryant's Triangle. In lesions of the hip the most useful measurement is the base of Bryant's triangle. With the patient supine, a vertical line is dropped from the anterior superior spine, and a horizontal line is drawn from the tip of the trochanter proximally to meet it. This latter line is the base of the triangle, and any reduction in its length compared to the sound side indicates shortening above the level of the trochanter due to coxa vara or a fracture of the femoral neck or dislocation of the joint.

Aspiration of the Hip To aspirate fluid from the hip introduce the needle about 2½ inches below and slightly medial to the anterior superior spine and pass it backwards, slightly upwards and medially

DEFORMITIES

Congenital Dislocation of the Hip

This deformity occurs most often in female children, and sometimes affects several members of a family It may be unilateral or bilateral.

Pathological Features. It is thought that the primary lesion is defective growth of the upper rim of the acetabulum, which permits subsequent dislocation The actual displacement may occur before birth, in infancy or when the child starts to walk.

In untreated cases secondary changes develop The acetabulum becomes shallow and fills with fat and fibrous tissue. A depression forms on the dorsum ilii ("the false acetabulum") where the femoral head presses. The femoral head is atrophic and deformed, and the neck of the femur is bent forwards (anteversion), so that the head points more forward than normally

The joint capsule, by which the weight of the pelvis is suspended, becomes stretched and thickened, and may develop an hour-glass stricture, which forms a serious hindrance to manipulative reduction of the displacement. The ligamentum teres is stretched or may be absent. The longitudinal muscles of the thigh undergo adaptive shortening

Clinical Features. The deformity should be recognisable in infancy by asymmetry in the hip region and by asymmetry of the skin creases of buttock and thigh.

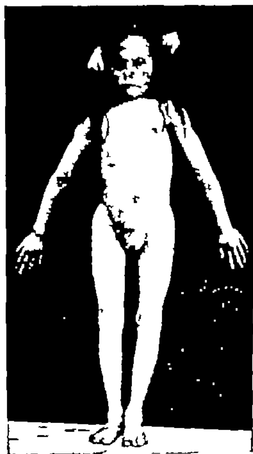


FIG. 95. Bilateral congenital dislocation of the hips. Note the lordosis and broadening of the perineum.

The child is late in learning to walk, and limps and lurches towards the affected side. The displaced head can sometimes be felt in the gluteal region, while there may be a hollowing in the femoral triangle in front, so that the femoral artery is less easily palpable there than on the normal side. Mensuration reveals shortening of the base of Bryant's triangle. Sometimes 'telescoping' of the thigh may be recognised

In bilateral cases additional features are present. The gait is of a waddling character with a lurch towards each side in turn. The hips are broadened and the perineum is widened The pelvis is tilted forwards and there is a compensatory lordosis.

Trendelenburg's Test. When a normal person stands on one foot

he adjusts his balance by tilting the pelvis so as to raise the opposite side slightly This movement is carried out mainly by the glutæus medius and minimus. When a person stands on a dislocated limb these muscles are powerless, for their normal fulcrum at the hip is lacking Consequently the pelvis is not tilted up but rather tends to sag Trendelenburg's test consists in observing the buttock while the patient stands on the affected leg Normally the buttock is raised slightly in congenital dislocation it is depressed

Treatment. In infants the dislocation reduces spontaneously as soon as the limb is abducted, and the essential treatment is to maintain the limb in this position for a few months, so that the acetabulum may develop normally This is achieved by strapping the lower limbs in wide abduction to two sides of a wood triangle or by fixing the legs in special types of harness or splint designed to prevent adduction

In older children traction should first be carried out on a frame. Sometimes reduction is hindered by the labrum glenoidale, the thick fibrous rim of the upper posterior part of the acetabulum, which becomes interposed between the femoral head and the socket. It may be demonstrated by X ray examination after arthrography and the labrum should be removed at operation After early successful reduction of the dislocation the atrophic bony rim of the acetabulum tends to develop normally

In late cases it is sometimes necessary to immobilise in a plaster case from the thorax to below the knees, with the hip in the 'frog position of right angle flexion, 45 degrees abduction and medial rotation The plaster is so applied as to allow some movement at the hip while maintaining wide abduction After twelve months' fixation, the plaster case is removed and massage and exercises are given. Walking is not allowed for a further period of three months.

If manipulation fails, or if subsequently the acetabular rim remains defective and recurrence seems likely, operation is performed. Reduction is effected and the upper rim of the acetabulum is levered out with a gouge and buttressed in its new position by a bone-graft.

In untreated cases in adults, if instability or pain or a secondary adduction deformity causes disability, a "bifurcation" operation is performed. The femur is chiselled through obliquely at about the level of the lesser trochanter so that when the foot is forcibly abducted by the assistant the upper end of the shaft abuts against the acetabulum, giving a fairly stable false joint.

Slipped Femoral Epiphysis

This displacement occurs principally in boys between the ages of 10 and 17 years. The epiphysis, which consists of the head of the femur alone, slips downwards and rotates backwards slightly while the rest of the bone—shaft, neck and trochanters—is drawn proximally by muscle pull. Later the separated head unites with the shaft in coxa vara deformity

Sometimes the displacement takes place acutely as a result of

trauma. The treatment then is to reduce by weight traction and then insert a Smith Petersen nail to prevent recurrence.

In other cases the displacement occurs insidiously as a result of some dystrophy of the bone. In such cases treatment is unsatisfactory

ACUTE ARTHRITIS OF THE HIP

Acute arthritis of the hip generally occurs as a complication of a grave septicæmia, especially in children, or secondary to osteomyelitis of the head of the femur

There may be severe pain especially on movement of the joint, with elevation of the temperature and severe toxæmia. On examination the joint is fixed by muscle spasm, and the slightest movement is painful An adduction flexion deformity develops rapidly The treatment is to administer antibiotics

TUBERCULOSIS OF THE HIP

This disease, now becoming less common, is due to blood borne organisms from some distant focus The bone undergoes atrophy especially at the upper rim of the acetabulum and the corresponding part of the femoral head where the bones are maintained in firm contact by the pull of the longitudinal thigh muscles. This leads to upward enlargement and excavation of the acetabulum and a pathological dislocation of the femoral head on to the dorsum ilii may occur

Clinical Features There may be a history of a minor injury *A limp* is often the first sign. It is protective in character to relieve the affected joint of weight bearing *Pain* is often referred along the obturator distribution to the medial side of the thigh or the knee. (Sometimes the first complaint is of a sore knee.) *Starting pains* occur when the articular cartilage is eroded. They are sudden intense pains, due to movement of the joint, and usually occur when muscle spasm is relaxed as the patient drops off to sleep *Limitation of movement*, due to protective muscle spasm, is an early constant feature. At first the limitation is slight, a few degrees short of the full range later there is almost complete stiffness *Muscle atrophy* is also a constant sign To estimate it observe the gluteal region which is flattened when the muscles atrophy and measure the girth of the thighs with a tape measure

The deformity is characteristic. Owing to the pull of the more powerful muscles the hip is adducted flexed and rotated medially In order to minimise the deformity when standing the patient raises the pubis on the affected side. To do this he raises the foot on tip toe, giving an appearance of shortening In severe cases with dislocation of the femoral head there is true shortening of the limb

The flexion deformity may be observed by compensatory lordosis It can be revealed by Thomas test (p. 174)

Diagnosis. The diagnosis is to be made from (1) injuries, e.g strain



Perthes disease of the femoral head.



Coxa vara due to old slipped epiphysis.



Deformed pelvis with bilateral coxa vara in a case of familial fragility of the bones.

[To face p. 178.

PLATE VIII



Tuberculosis of hip. Early case with osseous focus in femoral neck.



Tuberculosis of hip Acute stage with loss of joint outline and marked decalcification.



Tuberculosis of hip, with destruction of femoral head and excavation of acetabulum.



Pathological dislocation of the hip, secondary to tuberculosis with super added septic infection.

of the hip, (2) deformities, e.g slipped epiphysis (3) diseases e.g synovitis or Perthes' disease or rheumatoid arthritis.

X ray examination is valuable (opposite) If there is any doubt, a biopsy may be performed, with removal of a piece of synovial membrane.

Treatment. The general treatment for tuberculosis (p 81) should be carried out. In addition traction is carried out on an abduction frame to keep the joint at rest.

If bone disease is present, early operation is performed to curette out all necrotic tissue



FIG. 90. Tuberculosis of the left hip, of three months duration, untreated. The position of the limb is characteristic—the stage of "apparent shortening Note the muscle atrophy

OSTEOCHONDRITIS OF THE HIP (Legg-Calvé Perthes Disease)

Perthes disease, as this condition is usually named, is an affection of the femoral head, which undergoes softening and a disturbance of calcification. In some cases the acetabulum and the femoral neck are implicated to a minor degree.

Clinical Features. Perthes disease starts between five and nine years of age, and generally occurs in boys. The symptoms are of mild character and after an active period of a few weeks or months tend to pass off, even though evidence of the disease is still revealed by radiography

The onset is insidious. A limp protective in character is the first

indication. Pain is a variable feature, and is usually slight. At first there may be slight limitation of movement, just as in tuberculosis, but later the movements are free, except for some limitation of abduction and medial rotation. Unlike tuberculosis, there is little or no muscle atrophy

Radiographic Appearance. Contrasting with the relatively slight clinical manifestations, the changes visible on radiography are gross. The earliest sign is flattening of the epiphysis of the femoral head, with slight increase in density Then the epiphysis becomes "fragmented" and appears to consist of islands of dense sclerotic bone separated by zones of relative osteoporosis While this change is occurring the flattening of the epiphysis increases and the femoral head assumes a mushroom shape. The articular cartilage remains unaffected and consequently the "joint space," the distance between the bone ends, is not reduced—a point of distinction from tuberculosis.

Diagnosis. In its early stages Perthes' disease cannot be diagnosed with certainty from tuberculosis, but the treatment is the same. Later the contrast between the mild clinical course and the gross radiographic picture is characteristic (Plate VII, facing p 178)

Prognosis The symptoms of active disease tend to subside within a few months of the onset, but the changes in the bones persist for from one to three years After this time the bone structure returns to normal, although the mushroom deformity and the coxa vara persist. Later these deformities predispose to osteo-arthritis.

Treatment. In the active stages treat by recumbency with weight traction, as for a tuberculous hip Maintain this treatment for a year or eighteen months to prevent the development of deformity as far as possible. The method formerly adopted of traction for two or three months is now regarded as inadequate. Later apply a short plaster spica and fit a patten on the other foot to protect the hip for a further period of three months.

OSTEO ARTHRITIS OF THE HIP

The pathological features have already been described (p 123) The articular cartilages undergoing atrophy become thinned by pressure and eburnated over the central part of the joint surface, while at the joint margins they form cartilaginous excrescences and osteophytes. Similarly the bone of the head of the femur becomes atrophic in its central, weight bearing portion, while new bone "lipping" occurs at the margins, so that the femoral head becomes flattened and "mushroomed." A coxa vara deformity is a frequent secondary change.

Clinical Features. The main feature is stiffness of the joint, worse in the mornings and improving after exercise. Creaking can often be elicited. Pain is sometimes severe. It may be felt in the hip or be referred to the obturator or sciatic distribution. Radiographic examination shows diminution of the joint space, due to erosion of the cartilages. The head of the femur may be deformed and lipping is evident.

Diagnosis. The diagnosis is to be made from sciatica and in young

persons especially, from tuberculosis. The clinical features and the radiographic examination generally leave little room for doubt.

Treatment. If pain is severe, the joint may be fixed (arthrodesis) provided that the other hip is free from disease. Arthrodesis may be achieved by opening the joint, erasing all cartilage, and splinting with a bone graft.

An alternative line of treatment, especially suitable when both hips are stiff is to perform arthroplasty The joint is opened, all cartilage is erased and the articular surfaces of femur and acetabulum are carefully smoothed and rounded In successful cases a fair range of painless movement is obtained

ANKYLOSIS AND CONTRACTURE OF THE HIP

The causes and pathological features of ankylosis and contracture have been described on p 125

In the hip the common deformity is one of flexion, adduction and medial rotation. If the joint is diseased a pathological dislocation of the femoral head on to the dorsum ilii is a common complication.

The diagnosis is to be made from fixation due to muscle spasm associated with active disease of the joint, e.g tuberculosis. Rarely hysterical spasm may closely simulate organic disease.

The treatment is carried out according to the principles mentioned on pp 125 126 If the joint is ankylosed in good position and is painless treat ment is inadvisable, for a stiff, painless hip causes far less disability than a movable painful one. If there is osseous ankylosis in deformity a sub-trochanteric osteotomy should be performed to rectify the alignment of the limb If there is fibrous ankylosis with contracture, reduction may be attempted by weight traction or manipulation, combined, if necessary with tenotomy of the adductor muscles. As a preliminary to gradual reduction the unaffected thigh may be fully flexed and encased, along with the trunk, in plaster of Paris in order to fix the pelvis. If there is a flexion contracture with a healthy joint, due, for example, to infantile paralysis a muscle-slide operation is of value, by which the contracted structures on the anterior aspect of the thigh are elevated from the ilium and slid down the bone as the limb is straightened.

INJURIES OF THE HIP AND THIGH

Dislocation of the Hip

'Dislocation unqualified implies "traumatic dislocation" as distinct from congenital and pathological forms. It is a rare injury which results from severe forms of violence, such as a fall from a height, or a road or railway accident. It occurs mainly in young adults, for at other periods of life the bones are more brittle and break rather than dislocate. It is a rare injury but much studied by anatomist surgeons of yore.

The dislocation may be posterior anterior or central.

Posterior Dislocation. This displacement occurs if at the moment of impact the thigh is flexed, adducted and medially rotated The femoral head is forced through the postero-inferior part of the capsule and then displaced backwards.

The injury causes much pain and shock. The thigh is held flexed,

adducted and medially rotated. Movements of the limb are greatly restricted and painful. The *shortening amounts to 2 inches* or so The displaced head may be felt under the gluteus maximus, and there is a hollowing in the femoral triangle.

Radiography is always advisable, to exclude a coincident fracture of the acetabular rim, a common finding

The treatment is to reduce the dislocation under general anæsthesia. Careful preparation is necessary owing to the risk of shock The patient is placed supine *on a mattress on the floor* While an assistant grips the pelvis, the surgeon holds the limb with the knee at a right angle and lifts it as though to raise the patient off the floor He then flexes and adducts the hip next circumducts it laterally and finally brings it down into complete extension

After reduction a firm bandage is applied. If the acetabular rim is fractured continuous traction by weight and pulley is required to prevent redisplacement

Anterior Dislocation. This rare injury is due to forcible abduction of the thigh The femoral head escaping through the inferior part of the capsule, is forced forwards towards the obturator foramen or even to the pubis The thigh is held flexed, slightly abducted and laterally rotated. Movements of the limb are greatly restricted. In rare cases the displacement appears slight, and stiffness is the only complaint.

The treatment is similar to that for a posterior dislocation except that in the *manipulation the thigh is first abducted and flexed, then circumducted* medially

Central Dislocation. Here the acetabulum is fractured and the femoral head is forced medially through it towards the pelvic cavity A severe blow on the trochanter is generally responsible

Unreduced Dislocation. Manipulative reduction becomes progressively more difficult with the lapse of time, and is rarely possible after six to eight weeks In borderline cases it is advisable to apply powerful traction for several days before attempting reduction. If manipulation fails operative reduction may be attempted. *If this in turn fails a Lorenz bifurcation should* be performed (p 177)

Fracture of the Neck of the Femur

From the practical standpoint we may recognise two distinct fractures in this region, both common —

(1) Fracture of the narrow part of the neck (intracapsular fracture)
(2) Fracture of the base of the neck (pertrochanteric fracture)

Fracture of the Narrow Part of the Neck (Intracapsular Fracture) The brittle bones of old age are especially liable to this fracture. It is generally caused by some trivial form of injury such as tripping over a rug or twisting the foot while walking The torsion strain thus produced is transmitted to the femoral neck, which breaks in its weakest part.

The displacement is constant. The small proximal fragment, the femoral head, *remains normally in the acetabulum*, while the distal part, i.e. the whole shaft with the trochanters and the base of the neck, is drawn upwards and also rotated laterally

Clinical Features The clinical features in typical cases are

characteristic. At the time of the fracture the patient falls to the ground and is unable to rise. There is pain in the hip region, and the limb is powerless On examination, the leg is found to be rotated laterally with the foot everted almost flat on the bed Active movements are impaired so that the knee can with difficulty be raised a few inches and passive movement is painful On palpation the great trochanter is better defined than its fellow, for there is relaxation of the tense

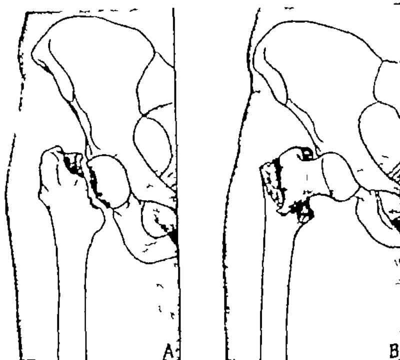


FIG. 97 Fracture of the neck of the femur (A) Intracapsular fracture, after six months, showing absorption of the femoral neck and non union. (B) Pertrochanteric fracture with coxa vara deformity

ilio-tibial tract of fascia lata which normally obscures its outline. Mensuration demonstrates shortening on the affected side, the base of Bryant's triangle being reduced by ½ inch or so, owing to the upward displacement of the trochanter Crepitus can rarely be obtained

In atypical cases, however many of these features are lacking, especially if the fragments are impacted. At the time of the accident the patient may be able to rise from the ground, and may even hobble some little distance. On examination, the movements at the hip may be little impaired The pain is variable, and the shortening may be so small as to escape notice. There is no discoloration in the hip region at first, though later some bruising may reach the surface. For these reasons the fracture may be missed or attributed to a sprain.

Progress This fracture is notoriously slow to unite, owing to (1) displacement of the fragments, (2) difficulty in immobilising them and (3) poor vascularity of the femoral head. Since the artery to the ligamentum teres is often obliterated in old age, the head is dependent

upon a blood supply by small vessels ascending from the region of the trochanter and some or all of these are torn when the neck is fractured.

Owing to its poor vascularity the femoral head may undergo *ischaemic necrosis*, remaining unchanged in outline or density in striking contrast with the vascular bone of the femoral neck which, in the course of months, becomes decalcified and later eroded.

Treatment. In the majority of cases the fracture should be reduced and immobilised by means of a Smith-Petersen pin. The nail is of

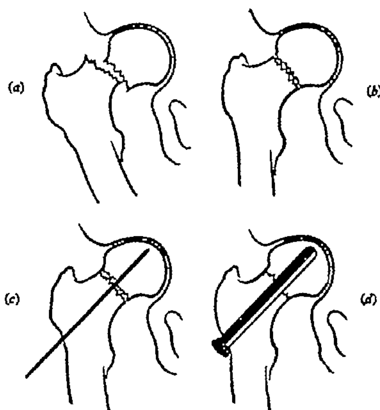


FIG. 98. Fracture of neck of femur treated by Smith-Petersen nail. (a) The displacement. (b) Displacement corrected. (c) Guide pin inserted (with X-ray check). (d) Nail driven home, pin removed.

stainless steel, to obviate the foreign body reaction caused by ordinary steel, and is fluted so as to control rotatory movement between the fragments. The nail is introduced through a small incision over the trochanter, its direction being accurately determined and subsequently checked by special radiographic methods. This method causes little shock. The patient is allowed to move freely in bed and after a few days is able to get up into a chair Thus the risks of prolonged recumbency are avoided.

Fracture of the Base of the Neck (Pertrochanteric Fracture) This fracture is also common in elderly persons, though it may occur in adults of any age. It, too may follow a trivial injury, such as a twist

of the foot, but more often is due to a direct injury caused by falling on the trochanter

The clinical features are similar to those of a fracture of the narrow part of the neck, and in addition there is generally some bruising at the site of injury and in some cases palpable broadening of the trochanter There is marked lateral rotation of the limb and the foot lies everted on the bed. The trochanter is displaced upwards, and the base of Bryant s triangle is shortened, often by an inch or more.

The diagnosis is confirmed by radiography

Prognosis The prognosis is entirely different from that of a fracture of the narrow part of the neck, for the blood supply to the base of the neck is generous and union proceeds normally especially if the fragments are impacted and thus completely immobilised

Treatment. Generally the fragments may be fixed by a Smith Petersen pin or a nail plate. Alternatively the Russell method of traction (Fig 90) may be used.

Fracture of the Shaft of the Femur

This injury may occur at any age, but is most common in healthy adults. It generally results from a severe form of violence. If due to direct violence, the fracture is usually transverse if to indirect, it tends to be oblique or spiral.

The lower fragment in almost all cases is drawn proximally by the pull of the long thigh muscles. The shortening may amount to 3 or 4 inches. The lower fragment is also rotated laterally by the weight of the foot. If the fracture is in the upper third of the thigh, the short proximal fragment is flexed at the hip by the pull of the psoas muscle and abducted by the glutei, if in the lower third, the short distal fragment is flexed at the knee by the pull of the gastrocnemius.

The diagnosis is usually obvious. Radiographic examination should always be made, however to determine the site and character of the fracture and the degree of displacement.

Treatment. The essence of treatment is to reduce the displacement and immobilise the part until union is complete.

To reduce the displacement, continuous powerful traction must be exerted in the long axis of the limb sufficient to correct the shortening Once the distal fragment is pulled down to length, the enveloping muscles tend to mould the bone into apposition. If necessary pressure pads may be used to secure exact alignment. Rarely if the displacement cannot be corrected by these means, operation may be required.

In young children one or both legs should be suspended by adhesive plaster from an overhead gallows, so that the sacrum is raised off the bed. The weight of the body then overcomes the shortening, and in most cases no further measures are required, except to see that the position is maintained for five or six weeks.

In older children and adults the limb is fixed in a splint such as Thomas and continuous traction provided Skin traction by adhesive strapping may be used, but many surgeons prefer skeletal traction by a

Kirschner wire or better, a pin driven through the tibia just deep to its tubercle.

Fixed traction may be used, the traction tapes being fixed to the lower end of the splint, which at its upper end bears against the tuber ischii Alternatively, balanced traction, by weight and pulley may be preferred

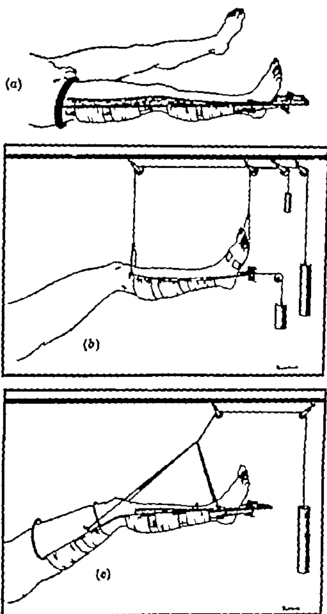


Fig 90 Types of splint used in the treatment of fracture of the shaft of the femur. (a) Thomas knee splint with fixed extension by skin tapes. (b) Russell's method of balanced traction. (c) Hodgen's splint. (Foot supports omitted.)

The weight is adjusted to individual requirements, from 15 to 20 lb., or even more. The position and alignment of the bones are checked by radiography and once the shortening has been corrected the weight is reduced. Routine radiographic examination should be carried out weekly until union is assured Especial care must be taken that the normal anterior curvature is preserved, for if the fractured part is allowed to sag a disabling *recurvatum* deformity results.

The Russell method of balanced traction is satisfactory (Fig 99) From a pin through the tibial tubercle traction cords are led in two directions, (1) vertically upwards, and (2) horizontally The leg is supported on slings attached to the horizontal cords. Dorsiflexion of the foot to a right angle is maintained by a separate weight and pulley This method ensures a good position yet by allowing the patient to move in bed it facilitates nursing and maintains good muscle tone

In fractures near the upper end of the shaft a Kirschner nail may be used This is inserted from the trochanter downwards along the narrow cavity

Whatever method is used, fixation must be maintained until radiography shows good union—generally at least ten to twelve weeks. The splint and traction apparatus is then removed. After a further few weeks, during which intensive physiotherapy is carried out, the patient is allowed up At this stage a walking calliper splint (Fig 100) may sometimes be advised The period of disability averages six months to a year In delayed union or non union, a not uncommon complication, the period of disability may be much longer

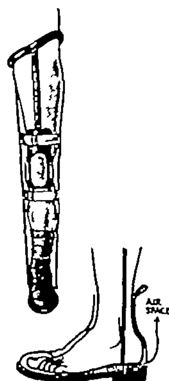


FIG. 100 Walking calliper splint. The weight is taken by the tuber ischii on the leather-covered ring The splint must be long enough to leave an air space below the heel of the foot.

Fracture of the Pelvis

Fractures of the pelvis may be divided into two groups (1) fractures of individual bones (2) fractures of the pelvic girdle.

Fractures of Individual Bones. Such exposed parts as the iliac crest, the anterior superior spine and the coccyx are liable to fracture through direct injury No special treatment is required

Fractures of the Pelvic Girdle. This type of fracture results from a severe crush—for example in a rail or road accident. There is considerable shock due to extensive extraperitoneal hæmorrhage and there may be other injuries, such as fractured ribs or rupture of a viscus Rupture of the urethra and rupture of the bladder are two important complications.

There are two types of fracture of the pelvic girdle —

Anterior Fracture This involves the horizontal and descending rami of the pubis on one or both sides, or the symphysis may be separated. The fragments may be widely displaced. There are much local pain and tenderness, with bruising over the pubis and perineum. The urethra and bladder may be damaged

"*Fore-and-aft* *Fracture* Here there are fractures of the horizontal

and descending rami of the pubis in front and a vertical fracture of the ilium or subluxation of the sacro-iliac joint behind The whole side of the pelvic girdle is affected and the loose portion, comprising almost the whole ilium, the ischium and the acetabulum, is displaced upwards, carrying the lower limb with it. The loose portion may also be rotated laterally and widely separated from the rest of the pelvis. The urethra and bladder are very liable to injury

The injury gives rise to much pain and severe shock. On examination, the lower limb is found to be powerless. The bony points on the affected side may be displaced upwards an inch or more, and lateral displacement may also be observed.

Treatment. The first step is to decide if the bladder or urethra is injured for treatment of the viscus then takes precedence over the fracture. If there is no complication, an attempt is made to reduce the displacement under anæsthesia and to maintain immobilisation for three months.

CHAPTER 20

THE REGION OF THE KNEE

Examination

THROUGHOUT the examination the affected knee is compared with its fellow

Inspection. The position of the knee is first noted for a slight degree of flexion deformity is a common sign of disease. Then the general contour is observed and especial attention is paid to fullness above and to either side of the patella, indicative of synovial thickening or of an effusion into the joint. Finally, the quadriceps must be examined, for atrophy and atony of this muscle are common features in many diseases of the knee.



FIG. 101. Examination of the knee. The "floating patella" test for fluid in the joint.

Palpation. First the line of the joint is palpated and any tender spot noted. Any swelling or fullness, indicating thickening of the synovial tissues or enlargement of a bursa, is also observed. With the knee straight, the patella is moved from side to side to determine whether it is fixed by adhesions to the lower end of the femur Next the classical test for fluid in the joint is carried out (Fig 101) A small amount of fluid in the joint can be demonstrated better if the patient is examined standing, with the feet together and the trunk bent forwards at the hips, so as to

relax the quadriceps. The fluid then causes a fullness at the sides of the patella, easily recognised by comparison with the normal side.

Movements. The normal range of movement of the knee is from 180 degrees extension to about 80 degrees flexion. During the last stages of extension a slight degree of lateral rotation also occurs—the 'screw home' movement—which tends to lock the joint, and thus greatly increases its stability whilst fully extended.

After these normal movements have been tested, examination should be carried out to determine the presence of abnormal movements, such as may result from stretching of the collateral or cruciate ligaments (pp 194 197)

Fracture of the Lower End of the Femur

Supracondylar Fracture. This may be produced by direct or indirect violence. Generally there is a transverse fracture immediately above the condyles. The distal fragment is tilted backwards by the

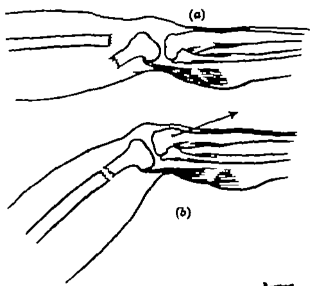


FIG 102. Supracondylar fracture of femur (a) The typical displacement. (b) Displacement reduced by traction with knee bent.

pull of the gastrocnemius, and may cause pressure on the popliteal vessels and nerves. The proximal fragment is displaced forwards, may be enmeshed in the fibres of the quadriceps muscle and may even perforate the skin.

The treatment is to apply skeletal traction by a pin or wire through the tibial tubercle and to immobilise the limb in a Thomas splint with the knee bent and with pressure pads to correct the displacement. The rest of the treatment is the same as for fracture of the femoral shaft.

In some cases there is a Y shaped fracture, involving the knee joint. The two condyles are then widely separated, and the joint is distended with blood. The treatment is as described above, with the addition that the lateral displacement of the condyles must be corrected by manipulation and that the fluid must be removed from the joint by aspiration.

Separation of the Lower Femoral Epiphysis. This rare injury occurs in children and adolescents, usually as a result of forcible hyperextension of the knee. The epiphysis is displaced forwards while the lower end of the shaft is forced back into the popliteal space where it may compress the vessels or damage the nerves. The treatment in young children is to reduce the displacement by manipulation and to apply a plaster with the knee in full flexion In adolescents manipulative replacement may be impossible if a sleeve of periosteum is carried between the fragments, and in such cases operative reduction is necessary

Fracture of One Condyle of the Femur This injury may result from a direct blow or from an indirect strain applied through the knee. The separated condyle is displaced proximally and in most cases the joint is markedly distended with blood The treatment is to aspirate the fluid from the joint, and then to effect accurate reduction of the displacement. In some cases this can be done by manipulation In others it is necessary to expose the fragment by operation and fix it in place by a screw After reduction, the limb is encased in plaster for eight or ten weeks.

Fractures of the Upper End of the Tibia

Transverse Fracture of the Upper End of the Tibia. This fracture results from a direct injury—for example, a blow by a car bumper Generally there is little displacement. The treatment is to correct the alignment and to encase the limb in a plaster cast, which is kept on for eight weeks

Fracture of One Condyle. This injury may result from a heavy weight falling on the flexed knee. The line of fracture is oblique and runs up into the joint, which becomes distended with blood. The loose fragment is displaced distally and to the side and a bow-leg or knock-knee deformity may result. The treatment is to reduce the displacement and to treat by traction in bed for a few weeks, later applying a plaster cast. If the displacement cannot be reduced manually the bone should be exposed and the fragment fixed in place by steel pins or bone grafts.

Fracture of Both Condyles. This injury is rare, and is generally due to a severe injury The condyles are separated widely and the upper end of the shaft may be driven up between them. The knee joint is filled with blood and the whole knee region is greatly broadened. The treatment is to apply traction to the tibial shaft and to attempt to manipulate the condyles into position If this fails, open operation is necessary

Fracture of the Patella

The patella may be fractured by a direct blow or indirectly by muscular action.

(1) When caused by a direct blow the fracture is irregular and often stellate, and, since the enveloping quadriceps expansion is not injured, the fragments are but little separated. The treatment is to aspirate the hæmorrhagic effusion that is generally present in the joint, and to apply a walking plaster cast, which is kept in position for six to eight weeks.

(2) The second type of fracture is much the commoner It usually results from an attempt to regain the balance when the knee is bent —for example, in descending stairs. There is a sudden, unexpected

contraction of the quadriceps muscle, and the patella is cracked across the rounded articular surface of the femur A transverse fracture results If the quadriceps expansion is undamaged the two fragments are but little separated. More often, however the expansion is torn across, and the fragments are separated by 2 inches or more.

The clinical features are characteristic. There is a sudden snap, followed by intense pain, and in most cases the patient falls to the ground. On examination the knee is distended with blood and the limb is powerless. There is tenderness on pressure over the patella, and generally there is no difficulty in palpating the separated fragments.

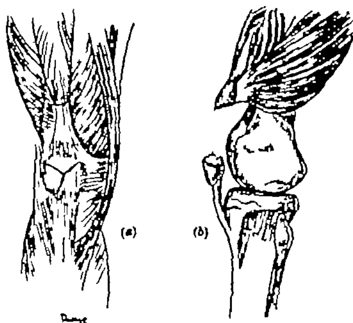


FIG. 103. Fracture of patella. (a) Stellate fracture without displacement. (b) Transverse fracture with rupture of quadriceps expansion and marked displacement.

The treatment depends upon the degree of displacement. If the two fragments are in close apposition the treatment is the same as for a stellate fracture. If there is more than ½ inch of separation, operation should be advised. The patella is exposed by a U-shaped or transverse incision the fragments being approximated and held together by stitching the overlying tendon and the torn quadriceps expansion at either side by silk or fascia lata sutures.

As an alternative, both fragments of the patella may be completely removed, the aponeurosis and its expansions being sutured carefully with silk or fascia. The immediate results are good, but later stiffness may develop

Rupture of the Quadriceps Insertion

The quadriceps muscle may rupture immediately above the patella as a result of a sudden muscular contraction The injury is thus caused in much the same way as a fracture of the patella, and the clinical features are similar

Quite a small tear may lead to crippling synovitis. The treatment is to repair the torn muscle by suture.

Dislocation of the Patella

The lateral displacement is the commonest type Frequently it is recurrent or habitual. The displacement is especially apt to occur if the lateral condyle is under-developed or if a knock knee deformity is present, for then the pull of the quadriceps muscle displaces the patella towards the lateral side

The displacement takes place during flexion of the knee and may be caused by a blow or kick or by muscular action On the first occasion there is considerable pain, the limb is rendered useless and the patient falls to the ground In recurrent cases the pain and disability may be slight.

The treatment is to reduce the displacement by extending the knee and flexing the hip so as to relax the quadriceps muscle In recurrent dislocation and in all cases of downward dislocation operation is required Many different procedures have been advised. If there is a knock-knee deformity it is corrected by osteotomy In other cases the tuberosity of the tibia with the insertion of the patellar tendon may be detached from the tibia and re-attached more to the medial side. In addition a reef may be put in the capsule medial to the patella, whilst the capsule lateral to the patella is incised longitudinally to relax its anchoring effect.

Contracture of the Quadriceps

As a result of prolonged immobilisation—for example in the treatment of a fracture of the femur—the limb may be rendered stiff in the fully extended position or be left with a very limited range of flexion The fixation is due partly to fibrous contracture of the muscle and partly to adhesion of the muscle to the anterior aspect of the femoral shaft. The treatment is by Bennett's operation which is designed to lengthen the quadriceps The quadriceps is divided above the patella separating the V-shaped tendon of the vastus intermedius from the other parts of the muscle and resuturing them after the joint has been fully flexed.

Osteochondritis of the Tibial Tuberosity

(Osgood-Schlatter Disease)

This condition is allied to other forms of osteochondritis or epiphysitis (p 104) It develops in the tuberosity of the tibia, which in some cases arises as a centre of ossification separate from the rest of the proximal epiphysis of the tibia.

The disease occurs mainly in boys between the ages of 13 and 17 It develops insidiously and gives rise to pain and tenderness in the region of the tuberosity especially after exercise Radiography shows the bony nucleus of the tuberosity to be in a state of irregular sclerosis, giving a fragmented appearance.

The diagnosis is to be made from traumatic displacement of the tibial tuberosity such as may result from forcible contractions of the quadriceps muscle. The treatment is to immobilise the limb on a splint or in plaster for six weeks, and subsequently to apply a knee cage to limit flexion

Dislocation of the Knee

This rare injury results from severe forms of violence. The tibia may be displaced forwards backwards, or to either side. The cruciate and collateral ligaments are of necessity torn or stretched (pp 104 107) and many of the muscles and tendons closely related to the joint are damaged. The popliteal vessels and nerves may be injured

The treatment varies according to the severity of the injuries If the

main vessels are injured, primary amputation is indicated. In other cases the dislocation should be reduced by manipulation and the limb encased in plaster in 15 degrees flexion. The plaster may be bi valved after six weeks to allow physiotherapy and walking may be permitted with a knee cage after eight weeks

Knock Knee and Bow Leg

These deformities were common when rickets was rife but are now rare. When seen in the active stages of the disease they were treated conservatively by rest in bed and various types of splintage. At later stages the deformity was corrected by osteotomy It is significant of the change in the face of surgery during the past seventy years that whereas Macewen who introduced osteotomy for these deformities performed the operation many hundreds of times his present-day successor has done so only in a single case.

INTERNAL DERANGEMENTS OF THE KNEE

The knee joint derives little strength from its bony configuration and owes its stability almost entirely to its ligaments, muscles and tendons Consequently it is peculiarly liable to various injuries of these soft structures. Owing to the normal angulation between the tibia and femur (which varies with the breadth of the pelvis) the ligaments and cartilage on the medial side of the joint are subject to greater stresses than those on the lateral side, and are considerably more liable to injury

The derangement varies from a simple sprain of one of the collateral ligaments to a lesion of the menisci or a more severe injury involving the cruciate ligaments.

Sprain of the Knee—Injuries to the Collateral Ligaments

This is a common injury, especially in workmen subject to severe strains. Recurrence is common. The medial collateral ligament is affected most frequently the result of an injury involving forcible abduction at the knee. In some cases the corresponding meniscus is also damaged

There is pain, with tenderness on pressure over the long attachments of the ligament. In severe cases the pain is increased if the ligament is put on the stretch by attempts to abduct or adduct the knee, and these movements may be abnormally wide.

In a simple sprain, a firm bandage suffices. A complete tear should be sutured.

Injuries to the Medial Meniscus

A displacement or tear of the medial meniscus is a common injury resulting from a sudden twist of the knee. Generally the meniscus is nipped between the apposed condyles of the femur and tibia, and causes acute pain and sometimes locking " of the joint. Often the meniscus is torn, and the loose tag is then very apt to cause recurrent pain and locking, followed by effusion of fluid into the joint. In chronic cases osteo-arthritis may develop

Mechanism of the Injury Displacement of the meniscus occurs when the knee is slightly bent, forced medially (i e. abducted) and suddenly twisted This sequence of strains is most apt to occur in footballers, during a sudden swerve, or in miners, turning from a crouching position at the coal face. Not infrequently, however the meniscus is damaged by an apparently trifling strain—for example, by stubbing the toes or twisting the foot on a kerb

Normally the meniscus is attached by its periphery to the deep surface of the medial collateral ligament, and is thus anchored in

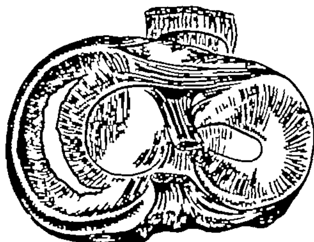


FIG 104. Bucket handle tear of medial meniscus.

position. If, however as a result of previous strain or from occupational stress, the collateral ligament is weakened and lax, the meniscus can slip between the bony condyles and become impacted Atony of the quadriceps muscle, a common result of any form of knee injury may also lead to laxity of the joint capsule and thus predispose to a meniscal injury

The actual mechanism of the displacement is probably as follows —

(1) The partly flexed knee is strained medially i.e. abducted. The relaxed medial collateral ligament then allows the joint to open on its medial side, and the meniscus, its peripheral attachment weakened slips deeply into the joint.

(2) The joint is suddenly rotated (generally the tibia is fixed by the foot planted on the ground, and the femur is rotated laterally by the body weight) The meniscus is then nipped and often torn.

Usually the meniscus is split longitudinally and the thin free margin, or " bucket handle," is then very apt to be displaced towards the centre of the joint.

Clinical Features. *In a typical case* at the time of the injury there is a sudden intense nauseating pain and the patient may fall to the ground. The knee is locked, that is, it cannot be extended The locking may become undone spontaneously or may persist until

manipulation is carried out. The knee rapidly becomes swollen by an effusion, which last several days

On examination, tenderness can usually be elicited on pressure over the *anterior end of the meniscus*, *especially* if the pressure is maintained while the joint is slowly extended. The tender point is situated at the level of the joint, about an inch medial to the patellar ligament. Occasionally if the meniscus is torn near its *posterior horn* the tenderness is most marked towards the back, just in front of the semitendinosus tendon.

In atypical cases locking does not occur The initial injury may be of quite trivial nature and the main feature is recurrent pain over the medial side of the joint, often with some instability of the joint and a tendency to recurrent swelling and stiffness

In recurrent cases the displacement of the cartilage may follow a quite trifling strain—for example, in tripping over a stone. The symptoms are similar to those of the original displacement, but less marked, and often the patient learns to reduce the displacement unaided If recurrences are frequent the effusion tends to persist, the ligaments become stretched the muscles, especially the quadriceps, lose their *tone, and the stability of the joint is impaired. Eventually the recurrent* traumatism may lead to the development of osteo-arthritis.

Diagnosis (1) A sprain of the medial collateral ligament is indicated if pain occurs when the ligament is stretched by abducting the knee or if there is tenderness on pressure over one of the attachments of the ligament, usually over the tibia, about ½ inch below the joint. But lesions of the meniscus and ligament may co-exist.

(2) Thickening of the infrapatellar pad of fat is indicated by tenderness behind the patellar tendon on pressure or on forcible extension of the knee.

(3) A loose body in the joint is indicated if the pain is atypical and the locking transitory A radiograph confirms.

(4) Arthritis is indicated by stiffness improved on exercise, by *creaking in the joint, and often by synovial thickening* A radiograph confirms

Treatment. To free a locked knee the joint is fully flexed, rotated medially and abducted so as to open up the interval between the medial condyles. Gentle alternate extension and flexion are then carried out till a full range of movement is possible. The patient usually knows when reduction has been effected, and there may be a recognisable snap. It is recognised also by the fact that full extension is at once possible. If the manipulation fails, it should be repeated under anæsthesia. After reduction an elastic bandage should be put on to limit the *effusion* and a *back splint* applied for a few days. Active exercises of the quadriceps should be instituted at once to prevent loss of tone. Subsequently a firm bandage should be used to give support to the knee. The medial side of the shoe should be raised by ½ inch to reduce the strain on the medial collateral ligament.

If the displacement recurs, or any other symptom persists, operation

should be advised without undue delay Removal of the cartilage causes no loss of function, and after two or three months the joint regains its normal stability It is a wise precaution always to radiograph the joint before operation to exclude a loose body or arthritis of the knee.

Injuries to the Lateral Meniscus

The lateral meniscus is less liable to injury than the medial meniscus but it may be torn by a mechanism similar to that which operates on the medial side as a result of a sudden twist of the bent knee Locking is rare, and in most cases the clinical features are similar to those of atypical cases on the medial side, as described above. The pain is on the lateral side and at the back of the knee, and the point of maximum tenderness is at the level of the joint, an inch or so lateral to the patella. The treatment is to remove the cartilage by operation.

Discoid Lateral Meniscus : Snapping Knee

This is a rare congenital deformity in which the lateral meniscus retains its embryonic disc shape. It may be symptomless but in some cases a thick transverse ridge across the middle of the cartilage interferes with the free movement of the femoral condyle on the tibia, and gives rise to a clicking or snapping sensation accompanied by visible separation of the bones

The treatment is to excise the meniscus

Rupture of the Cruciate Ligaments

The cruciate ligaments may be torn in severe injuries to the knee. Almost always the other ligaments and the capsule of the joint are injured

The anterior cruciate ligament is normally tense when the joint is extended and it is liable to injury on hyperextension especially if combined with medial rotation The injury may be suspected if when the knee is straight, the tibia can be displaced forwards on the femur

The posterior cruciate ligament is normally tense when the joint is flexed and it is liable to injury on hyperflexion—for example, by a fall on the bent knee. The injury may be suspected if, when the knee is bent the tibia can be displaced backwards on the femur

In the treatment, early movement is encouraged, with "quadriceps drill" from the first, to prevent loss of tone Very rarely operation may be considered to introduce tendons or fascia lata in place of the damaged ligaments

Fracture of the Tibial Spine

The spine of the tibia is liable to fracture in severe injuries associated with rupture of the anterior cruciate ligament, which is attached to it, or it may be sheared off by the pressure of a femoral condyle in a sudden twist of the knee.

If the fragment is displaced, there is severe pain, and the knee cannot be extended. If it is not displaced the symptoms are comparatively slight. The diagnosis is confirmed by radiography If the fragment is badly displaced it should be removed or replaced in position by open operation.

Thickening of the Infrapatellar Pad of Fat

The pad of fat behind the patella and the patella ligament adjusts itself to the varying shape of the joint throughout its range of movement. Normally when the joint is fully extended, the pad of fat is drawn upwards by the pull of the quadriceps muscle, and thus escapes being caught between the approximating articular surfaces. If the pad is enlarged from any cause, or if the tone of the quadriceps is diminished, the pad is not properly drawn upwards and may be nipped. Such trauma, if repeated, leads to swelling of the fat, to hæmorrhages into its substance, and eventually to fibrous thickening

pus and the overlying skin is hot, red and tender The constitutional signs of sepsis are present. The disease is to be diagnosed from suppuration within the knee by the fact that the swelling is entirely in front



FIG. 106. Cyst of lateral meniscus of knee



FIG 107 Chronic prepatellar bursitis in a housemaid. The wall of the bursa is thickened and leathery There is a discharging sinus, due to superadded infection.

of the patella. Penicillin may be given by the intramuscular route, or locally into the bursa after aspirating the pus. If the infection does not subside, the treatment is to drain the abscess through two incisions, one at either side of the swelling

Chronic prepatellar bursitis (housemaid's knee) results from recurring traumatism, caused by much kneeling on hard floors There is a recurrent distension of the bursa with fluid The pain is variable In the course of time the wall of the bursa becomes thickened and fibrous, and eventually there is a thick, leathery plaque in front of the patella. The treatment is to excise the whole bursa.

Semimembranosus Bursa. This bursa, situated between the semi membranosus tendon and the medial head of the gastrocnemius, may be involved secondarily to joint disease, e.g tuberculosis, or it may undergo chronic inflammatory changes from repeated traumatism The latter condition is common in shepherds and others accustomed to rough walking The distended bursa forms a swelling between the two muscles, which is rendered tense when the limb is straightened Extension of the knee is slightly impaired and causes some pain. The treatment is to excise the bursa.

CHAPTER 21

THE LEG, ANKLE AND FOOT

Examination

THROUGHOUT the examination the affected limb should be compared with its fellow

Inspection. The gait should be observed, first with the patient fully shod and then barefooted. The footwear should also be inspected for abnormal wear which may be an indication of faulty posture or of a deformity such as flat foot.

Then the patient is examined standing, with particular attention to the arches of the foot and to the stance adopted when he stands at ease Next he is examined seated, so as to relieve the arch from weight bearing Finally attention must be paid to the general attitude and habitus, for these are often related to foot deformities A patient with flat foot, for example, may be splay footed knock kneed and round shouldered and may also suffer from hallux valgus or rigidus. All such features should be noted.

Palpation. Palpation is of especial importance in injuries of the limb. First the bony points below the knee are felt, the tibial condyles, the tibial tuberosity and the head of the fibula. Next the subcutaneous surface of the tibia is traced down to the medial malleolus and any irregularity or tenderness noted. Next the malleoli are compared, it being remembered that the lateral malleolus is normally about ½ inch below and behind the level of the medial one.

The bony points of the foot are then palpated. The outline of the calcaneus, the tubercle of the navicular and the prominent base of the fifth metatarsal are readily felt, and any tenderness over the metatarsals or in other parts of the foot is noted. The presence of œdema is also observed.

Movements. The movements of the ankle, the mid tarsal joint and the joints of the great toe are most important. The flexibility of the longitudinal and transverse arches should also be tested. At the ankle dorsiflexion to a right angle is essential for a comfortable take-off in walking This movement is often impaired if the foot has been immobilised in plantiflexion, as may happen in a badly reduced fracture, or even in a bedridden person from the long-continued weight of the blankets.

The mid tarsal joint is examined by gripping the foot with the two hands and attempting to rotate the anterior part (Fig 47) Normally a slight range of rotation is possible. Finally the proximal joint of the big toe is examined Here the important movement is dorsiflexion, which is necessary for a comfortable "take-off" in walking This movement is impaired in hallux rigidus.

INJURIES

Fracture of the Shafts of Tibia and Fibula

The tibia or fibula may be fractured separately, usually as a result of direct violence. Generally the fracture is transverse with little displacement.

Fracture of both bones is much more common If due to direct violence, the fractures are transverse and at the same level. If due to indirect violence such as a torsion strain of the foot, the fractures are oblique or spiral, and at different levels. The tibia is generally broken at the junction of its middle and lowermost thirds the fibula at the junction of its middle and uppermost thirds.

The fracture is often compound Indeed, this is quite the commonest of compound fractures. The skin may be broken by the impact of the object causing the fracture, and then there is a grave risk of severe contamination from foreign matter driven into the tissues or the skin may be broken from within by the pointed lower end of the upper fragment, in which case the risk of contamination is smaller

In severe fractures, especially with much displacement, the leg becomes greatly swollen and discoloured and the skin may be blistered The main vessels may even be torn or compressed by the hæmatoma and the vitality of the foot endangered.

Prognosis. The prognosis varies according to the type of fracture. In a simple transverse crack the period of disability is about three months in a severe spiral one it may be five or six months, or even longer

Treatment. *Transverse fracture of one or both bones* Here the treatment is to reduce the displacement and encase the limb in plaster The displacement is reduced under general or local anæsthesia, with particular attention to the alignment of the tibia The position of the fibula is of less importance. Plaster of Paris is then applied as for Pott s fracture (Fig 109) but extending up to the mid thigh, with the knee flexed to prevent rotatory movement at the site of fracture. Care must be taken while preserving the alignment to keep the foot dorsiflexed to a right angle. The patient must be kept under close supervision for twenty four hours, and if the foot becomes cold, blue or numb the plaster must be split down the front to relieve pressure. The plaster is left in place for eight weeks.

Oblique or spiral fracture This type of fracture may be treated by continuous traction, or preferably by fixing the fragments with vitallium screw

Fractures at the Ankle. Pott s Fracture

The term "Pott's fracture" is commonly applied to a variety of fractures in the ankle region. Typically the fibula is fractured near its lower end, the ankle is displaced laterally and either the deltoid ligament is torn or the medial malleolus is avulsed. Usually the injury is caused

by forcible abduction or eversion at the ankle, such as may result from falling on the everted foot. In addition there may be a posterior marginal fracture of the tibia.

Diagnosis In a severe case the characteristic abduction-eversion deformity, combined with lateral displacement, leaves no doubt as to the diagnosis, even though the bony points are obscured by swelling In a mild case if there is little or no displacement, the injury may be mistaken for a sprain of the ankle An important feature is the presence of localised tenderness over the fibular fracture and over the tip of the medial malleolus In all cases the diagnosis should be confirmed by radiographic examination

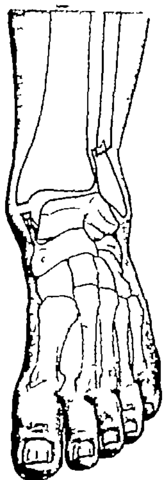


FIG 108 Pott's fracture.

Treatment In this fracture accurate reduction is essential, for the slightest displacement alters the statics of the foot, predisposes to flat foot and causes prolonged disability

Reduction is effected under general anaesthesia. The knee is flexed over the end of the table in order to relax the gastrocnemius, and the toes are supported by the surgeon's knee (the surgeon being seated) The foot is then manipulated into position with especial care to abolish the lateral displacement, to correct the eversion, and to secure dorsiflexion of the ankle to a right-angle.

After reduction the limb is encased in plaster applied over stockinette. The plaster should extend from beyond the toes up to the level of the tibial tuberosity A posterior slab is first applied and moulded gently round the bony prominences of the ankle and finally secured in position by a circular plaster bandage. When the plaster has set, the alignment is checked by radiography It is important that the talus should fit snugly into the angle between the medial malleolus and the distal surface of the tibia, and that there is no anterior or posterior displacement.

The limb is elevated on a pillow to reduce swelling If the toes become blue or cold or numb, or the foot painful, the plaster should be split down the front and the limb kept elevated for a week. In most cases the circulation is satisfactory and after two weeks a stirrup can be incorporated and walking allowed Instead of a stirrup a 4-inch section of car tyre may be fitted to the foot and held in place by laces The plaster is left on until radiography indicates firm union (usually

(a) (b)

Fig 100 Pott's Fracture (a) method of reducing displacement (b) the plaster applied.



Fig. 110 Malunited Pott s fracture.

eight to ten weeks) and then replaced by an elastic adhesive bandage to prevent late œdema. In all cases in which the foot is encased in plaster care must be taken first that the foot is dorsiflexed to 90 degrees, and secondly that the plaster is moulded under the foot to maintain the arches.

Operative fixation by a screw is indicated if the medial malleolus is fractured or if the tibio-fibular ligament is torn.

Sprain of the Ankle

Any of the ligaments of the ankle may be stretched or partly torn by a twist of the ankle insufficient to cause a fracture. The powerful deltoid ligament is rarely affected, however and the majority of sprains affect the lateral ligaments, especially the anterior talo-fibular and the calcaneo-fibular ligaments.

At the time of the injury there is an acute tearing pain over the affected ligament. On examination, tenderness is elicited by direct pressure or by passive movements that put the ligament on the stretch. The diagnosis from a fracture is made by radiographic examination.

The treatment is to apply a firm elastic bandage for a few days, and then to support the ankle by adhesive strapping applied as a figure of eight, so that it passes over the site of injury in the direction of pull of the damaged ligament so as to relax it. A pad of adhesive felt should be fixed under the strapping at the site of injury to dissipate the œdema. The sole and heel of the shoe should be thickened on the appropriate side to relax the strain on the affected ligament.

Dislocation of the Ankle

In the majority of cases of this rare injury there is a posterior dislocation accompanied by fracture of the posterior margin of the tibia (see above) Rarely an anterior or posterior dislocation may occur without fracture.

The displacement is easily recognised, and radiographic examination is needed only to exclude a fracture. The treatment (in a pure dislocation) is to reduce the deformity and to encase the limb in plaster for four weeks

Fracture of the Calcaneus

This not uncommon fracture results from a fall from a height on to the feet. Often both feet are affected.

The patient is unable to stand or walk without great pain On examination, there is tenderness limited to the calcaneus, the heel is broadened and often there is much bruising

The site and extent of the fracture must be demonstrated by both lateral and "axial radiographs—the latter taken by directing the rays posteriorly and obliquely upwards through the heel, with the foot powerfully dorsi flexed.

In some cases there is a linear fracture through the posterior process, or occasionally the sustentaculum tali in others, a vertical fracture in the mesial plane involves the subtaloid joint, with or without displacement of the joint surfaces in the most severe cases the calcaneus is severely crushed and comminuted—flattened from above downwards

and broadened from side to side—and the subtaloid joint is badly damaged

Fracture of the calcaneus is one of the most difficult of all fractures to treat satisfactorily At the present time most surgeons do not attempt any active measures The patient is kept at rest for several weeks and subsequently an elastic adhesive bandage is applied to prevent oedema. Late disability is especially apt to occur when the subtaloid joint has been involved, and it is sometimes necessary to arthrodese this joint.

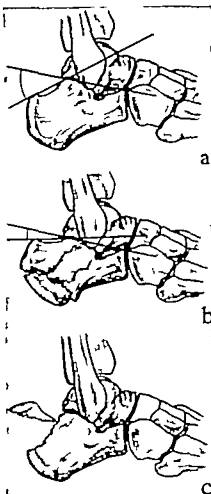


Fig. 111 Fracture of the calcaneus. (a) Normal foot, showing Böhler's "salient angle." (b) The common crush fracture, due to a fall on the heel from a height. The salient angle is greatly reduced. (c) Avulsion of the posterior process of the calcaneus.

Rupture of the Plantaris

The plantaris muscle or tendon may undergo rupture as a result of a sudden contraction—for example, when rising quickly on the toes in tennis or badminton There is a sudden stinging pain in the calf over the point of rupture, aggravated by active plantiflexion of the foot.

Rupture of the plantaris cannot be distinguished from a strain of the other calf muscles, and, though often diagnosed, it is probably somewhat rare. The treatment is to rest for a few days. It is useful also to raise the heel of the shoe. Massage and diathermy may be advised The disability subsides rapidly

Rupture of the Tendo Achillis

This injury occurs in adults as a result of a sudden muscular contraction—for example, in rising quickly on the toes in tennis or badminton. In most cases the tendon is torn completely across at a point 1 or 2 inches above its insertion. There is a sudden intense pain behind the heel, and the patient can only walk with great difficulty On examination, the gap in the tendon may be felt, but this sign is soon obscured by swelling due to extravasated blood. Active plantiflexion is greatly impaired, for it depends upon the comparatively feeble action of the tibialis posterior the peroneus longus and the long flexors of the toes. Passive dorsiflexion of the foot is unusually free. In some cases the bellies of the calf muscles are seen at a higher level than on the sound side.

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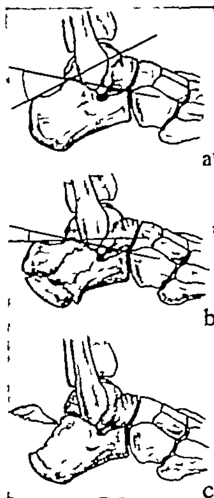


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The treatment is to expose the site of rupture without undue delay and repair the defect. The limb is then encased in plaster for three or four weeks, with the knee flexed and the foot plantiflexed to relax the tendon

PAINFUL HEEL

Apart from injuries pain in the region of the heel may result from the following conditions:—

Strain of the Tendo Achillis This affection results from excessive use e.g after much walking or jumping There is pain over the back of the heel with tenderness on pressure over the tendo Achillis The treatment is to apply strapping and to rest the foot for a few days

Calcanean Bursitis. This is a traumatic inflammation of an adventitious bursa superficial to the tendo Achillis or of the bursa deep to the tendon just above its insertion It generally results from the pressure of ill-fitting shoes. There is a fullness present over the affected bursa and the overlying skin may be reddened. There is tenderness on direct pressure and on dorsiflexing the foot. The treatment is to relieve pressure by providing a properly fitting low-heeled shoe, with a leather pad inside the heel, so that the bursa is raised above the level of the back of the shoe. In rare cases of chronic thickening of the bursa it should be excised.

Calcanean Apophysitis (Sever's Disease) This is a form of osteochondritis (p 104) affecting the posterior epiphysis of the calcaneus which is situated at the point of insertion of the tendo Achillis. It occurs mainly in boys between eight or nine years when the epiphysis appears, and 14 years when it fuses with the main centre.

The condition gives rise to pain and tenderness at the back of the heel. Radiographic examination shows the epiphysis to be broadened and in a state of patchy sclerosis. The treatment is to envelop the heel in adhesive strapping and raise the heel of the shoe in order to relieve the part from strain. In more severe cases a plaster may be applied for a few weeks

Calcanean Spur Here the pain is situated on the plantar aspect of the heel over a small pointed bony outgrowth near the anterior part of one of the cancanean tuberosities The spur is believed to arise from tearing of the periosteum as a result of repeated strains of the plantar fascia, which is attached to the bone at this point.

The pain is localised to a small area, which is very tender on pressure The spur can be demonstrated by radiography

The treatment in an acute case is to rest in bed for a few days and to apply fomentations Later a sponge rubber pad should be placed under the heel, with a hole corresponding to the tender area. Hydrocortisone injections are sometimes of value

KOHLER S DISEASE OF THE TARSAL NAVICULAR

This condition is regarded as a form of osteochondritis It occurs much earlier than other types of this disease however and is found generally between the ages of three and six. There is a painful limp and to relieve the navicular of pressure the child walks on the outer side of the foot. On pal pation there is tenderness over the navicular and there may be some superficial oedema. Radiography shows the bone thinned and sclerosed, " like a sixpence on edge " (Plate IX, facing p 217)

The diagnosis is to be made from tuberculosis.

The treatment is to encase the limb in plaster for six weeks and then to apply adhesive strapping to support the mid tarsal region.

DEFORMITIES OF THE FOOT

The Arches of the Foot

The bones of the foot are disposed in two main arches designed to afford resilience in standing or walking

The Longitudinal Arch. This is the more important arch It extends from the calcanean tuberosities forwards to the heads of the metatarsal bones. The posterior pillar of the arch is formed by the oblique lie of the calcaneus the anterior pillar on the medial side by the navicular the cuneiforms and the medial three metatarsals and on the lateral side by the cuboid and the two lateral metatarsals The keystone of the arch is the talus.

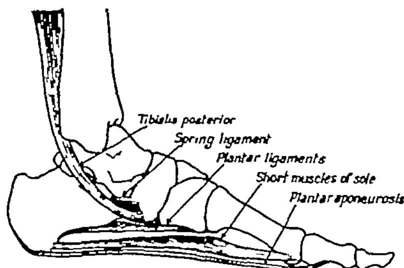


FIG 112. The longitudinal arch of the foot.

The integrity of the arch is maintained by ligaments and muscles.

(1) The individual bones are bound together by the various interosseous ligaments.

(2) The spring ligament, or inferior calcaneo-navicular ligament, a short powerful band, extends from the sustentaculum tali of the calcaneus forwards to the plantar surface of the navicular It binds these two bones together and also gives support to the head of the talus, which rests upon its upper surface.

(3) The long plantar ligament extends from the plantar surface of the calcaneus forwards to the cuboid and the metatarsal bones, and binds the two pillars of the arch together

(4) The plantar fascia, extending from the tuberosities of the calcaneus forwards to the toes, acts as the tie beam of the arch

(5) These ligaments are reinforced by all the muscles inserted into the foot which, by their synergic contractions, bring the arch to attention " ready to support the body weight.

The Transverse Arch. This is a shallow transverse arch formed by

The treatment is to expose the site of rupture without undue delay and repair the defect. The limb is then encased in plaster for three or four weeks, with the knee flexed and the foot plantiflexed to relax the tendon.

PAINFUL HEEL

Apart from injuries pain in the region of the heel may result from the following conditions —

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The diagnosis is to be made from tuberculosis

The treatment is to encase the limb in plaster for six weeks and then to apply adhesive strapping to support the mid-tarsal region.

DEFORMITIES OF THE FOOT

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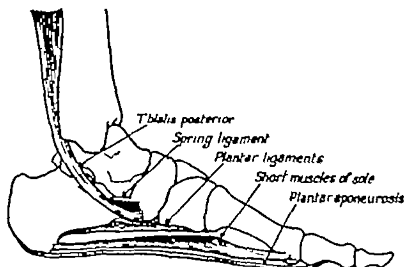


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(5) These ligaments are reinforced by all the muscles inserted into the foot which, by their synergic contractions, bring the arch ' to attention ready to support the body weight.

The Transverse Arch. This is a shallow transverse arch formed by

the heads of the four metatarsal bones. It is maintained by the inter metatarsal ligaments, and to a small extent by the oblique pull of the tibialis posterior and peroneus longus muscles. It is a weak arch, normally obliterated by the weight of the body in walking

FLAT FOOT (PES PLANUS)

In this common deformity the longitudinal arch of the foot is flattened and often, in addition, the fore part of the foot is pronated (pes valgus) The metatarsal arch is generally weakened too

The common type is known as "static flat foot." Paralytic, traumatic and spastic types are also recognised.

Static Flat Foot

This is by far the commonest form of flat foot. It generally comes under notice in youth, and for this reason is often called *Adolescent Flat foot*, but it may come on at any age. It is not uncommon in stout elderly people, especially stout females.

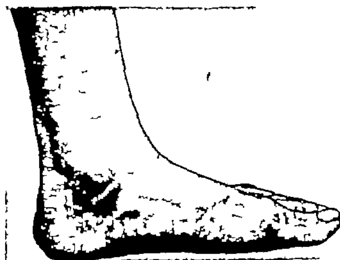


Fig. 113. Static (adolescent) flat-foot with hallux rigidus. The arthritic swelling of the proximal joint of the great toe is clearly visible.

In the flexible foot of youth, the main need is for resilience, which depends chiefly on the tone of the muscles of the foot and leg Thus it happens that the baby the ballet dancer and the athlete often have a very flat foot with no symptoms indeed in ballet dancing and some forms of athletics the extreme flexibility of the flat foot is almost a *sine qua non*.

A flat foot may give rise to symptoms when the muscle tone becomes impaired or when, as with increasing adiposity the load applied to the arch becomes excessive. Thus "static flat foot results from a disproportion between the strength of the arch and the weight which it bears. In the common adolescent form the essential factor is weakness or laxity of the ligaments and muscles supporting the arch. In many

cases there is an inherited or familial tendency aggravated by debilitating illness.

In older persons flat foot is often due in part to increasing adiposity The "fallen arches" of stout adults form a particularly difficult clinical problem.

Clinical Features Flat foot gives rise to aching pain and stiffness after exercise. Corns often result from the abnormal pressure of the shoe, and secondary postural effects, such as backache or sacro-iliac strain, may develop

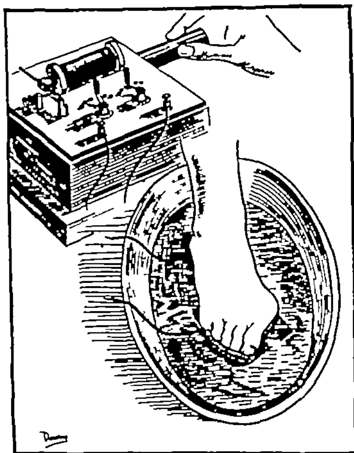


FIG. 114 Treatment of flat-foot by faradism.

When the patient comes in for examination, his gait is noted to be clumsy and lacking in resilience. When his shoes are removed they are seen to be worn excessively on the medial side of the sole. When he stands barefooted the arch is seen to be flattened and the fore part of the foot may be pronated. The foot is long and narrow When viewed from the back, the calcaneus is seen to be tilted laterally so that the medial malleolus is unduly prominent.

(*a*) Pay attention to the general health, for anæmia or other mild chronic ailments are the chief cause of the loss of muscle tone in adolescent flat foot. In older patients correct any adiposity

(*b*) Improve the muscle tone by exercises. These should be done

twice daily and include rising on the toes with the feet inverted and rising on the lateral border of the foot. The patient should be urged never to stand immobile, but rather when standing to keep continually on the move, rising on the toes or moving from one foot to the other When seated he should exercise his foot muscles as often as possible by clawing the foot and circumducting it as though drawing a circle with the big toe.



Fig 115. Spastic flat foot. Note the tense peroneal tendons.

(c) In more severe cases have the patient attend a physiotherapy department for similar exercises and for electrical treatment, the foot being placed in a bath of saline and stimulated by faradic current to exercise the deep muscles of the sole.

(d) Provide correct footwear If possible, the shoes should be specially fitted by a competent shoemaker They should be a good fit, firm and tight round the heel, accurately moulded at the waist, but flexible and roomy in front. The medial edge should be straight or even concave, with sufficient room for the great toe A crooked heel may be fitted, the heel being raised a little and projecting forwards for 1½ inches on the medial side, so as to support the waist of the shoe.

(e) In late cases, an arch support may be provided Supports are made of felt pads, sponge rubber or spring steel Of these, the sponge rubber ones are generally the most satisfactory They should preferably be made from a plaster cast constructed for the individual case. To make the cast, mould the foot into good position and apply a skin tight plaster bandage. Split and remove the bandage before it sets firmly and later obtain a positive cast by filling it with plaster

Paralytic Flat Foot. This type of deformity arises from paralysis of the tibialis posterior and the muscles of the sole, generally as a result of infantile paralysis. A severe degree of flat foot results. The treatment in the first place is to give the general treatment for infantile paralysis and to apply massage and galvanism, keeping the affected muscles protected from stretching by suitable splints. If these measures fail it may be necessary to arthrodese the tarsal joints.

Traumatic Flat Foot. This is a troublesome sequel to severe strains or crush injuries of the foot and to fractures in the region of the ankle

Pott's fracture is especially liable to this complication, owing to the eversion of the foot, which persists unless the displacement has been accurately reduced The best treatment is preventive, by proper treatment of the causative lesion. In an established case the treatment is as for a severe case of static flat foot.

Spastic Flat Foot. This acutely painful condition is now believed to be due to strain caused by congenital fusion of some of the tarsal bones, usually the talus and calcaneus or the navicular and calcaneus

The treatment is to protect the foot from weight bearing for a few weeks, either by rest in bed or by the application of a plaster cast.

Anterior Flat Foot. The anterior (metatarsal) arch is frequently flattened in cases of pes planus, and occasionally this is the chief feature of the case. There is an aching pain under the metatarsal heads, worse after exercise. The fore-foot is visibly broadened and flattened and often there are painful callosities under the ball of the foot.

The treatment is similar to that of the common form of flat foot, which generally co-exists. Often a small pad of felt placed under the metatarsal necks brings great relief

CLAW FOOT (PES CAVUS)

This deformity is characterised by an abnormally high longitudinal arch. It is regularly accompanied by clawing of the toes.

Causes Claw foot consists essentially of plantiflexion of the forepart of the foot the hind part remains in its normal relation to the leg The deformity results from hypoplasia and consequent contracture of



FIG. 116. Pes cavus, in a woman aged 40 who complained of stiffness in walking and painful callosities under the ball of the foot.

the ligaments on the medial side of the sole. In its milder forms it is quite common, and as a rule no cause is apparent. More severe forms may result from spina bifida (p 240) and occasionally from poliomyelitis.

Clinical Features In the early stages the child is noticed to be

clumsy in walking and very apt to fall. Later there is pain in the foot, especially on walking and tender callosities develop under the heads of the metatarsals. Corns also develop over the prominences of the hammer toes.

On examination the increased arch of the foot is apparent. At an early stage it can be corrected by upward pressure with a finger against the plantar aspect of the first metatarsal head. Later the deformity is a rigid one. As a result of the increase in the arch and the clawing of the toes, the foot is considerably shortened. In late cases a secondary varus deformity may appear and hammer toe deformities may develop owing to the altered line of pull of the tendons.

Treatment. The treatment varies according to the degree of clawing. In an early case the foot should be manipulated at frequent intervals by the child's mother or an older patient may be instructed to manipulate it himself by pressing the forefoot against any convenient object at every available opportunity.

In more severe cases a wedge resection is indicated.

CLUB FOOT

Pes Equino-Varus. In this, the commonest form of club foot, the heel is drawn up and there is a varus displacement of the fore part of the foot, with inversion of the whole foot. The deformity is a complex one. The heel is drawn up and the whole foot is inverted, so that the sole

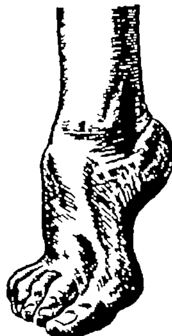


FIG. 117. *Talipes equino-varus with claw foot in a boy aged 11 suffering from spastic paralysis due to a birth injury.*

faces medially. In addition, the fore part of the foot is adducted in relation to the hind part, so that the medial border of the foot is concave. Sometimes a fourth displacement is present, a medial rotation of the lower end of the tibia.

The soft tissues—muscles, ligaments and fasciæ—are all contracted on the medial, concave side of the foot. The spring ligament, in particular, is greatly thickened and contracted

Congenital pes equino-varus may occur as a familial affection. When seen in infancy the deformity may be corrected manually, and the correction maintained by adhesive strapping by a straight lateral splint, or by Denis Browne's splints. The last named consist of bent L-shaped strips of aluminium (one for each foot) fixed by adhesive strapping to the sole of the foot and the lateral aspect of the leg The two splints are clamped to a transverse bar with the feet widely everted so as to correct the deformity while preventing muscle atrophy

In children the best treatment is by wedge plasters. A skin tight plaster is applied and a wedge cut out on the lateral (convex) side. The foot is then manipulated into better position, and a covering plaster applied to maintain the correction. This is repeated at intervals until correction is complete.

In resistant cases the contracted structures on the medial side and plantar aspect of the foot should be divided Division of the tendo Achillis and the posterior capsule of the ankle may also be required Finally in the most severe cases, in adolescence, a wedge of the tarsus should be resected, and the foot finally stabilised with the deformity corrected.

Acquired Pes Equino-varus follows paresis of the peroneal muscles and the long extensors of the toes due to poliomyelitis, progressive muscular atrophy or to an injury to the peroneal nerve The unopposed action of the calf muscles then distorts the foot into the position of equinovarus.

The treatment in the first place is to prevent the deformity by means of a splint and to strengthen the weakened muscles by massage and electrical stimulation. If the paralysis proves permanent, the weakened muscles may be reinforced by transplanting the tibialis anterior into the cuboid or the fifth metatarsal.

AFFECTIONS OF THE METATARSAL BONES

Fracture of the Metatarsal Bones

This injury may result from a direct blow or a crush of the foot. Often two or more of the bones are broken. The fore part of the foot is greatly swollen and bruised and tenderness can be elicited by direct pressure on the site of the fracture or by longitudinal pressure on the corresponding toe. The diagnosis is confirmed by radiography

If there is no displacement, the treatment is to apply a pad and strapping

If the fragments are displaced, accurate reduction must be obtained by manipulation combined with traction on the toes. A plaster is then applied, the traction being maintained if necessary

Fracture of the base of the fifth metatarsal results from coming down

heavily on the inverted and plantiflexed foot. There is pain, with tenderness at the site of fracture, aggravated by inverting the foot. The treatment is to bind the foot with adhesive strapping and to prohibit dancing for a few weeks. Exercises should be encouraged from the first.

Metatarsal Dystrophies

The forefoot has undergone fundamental changes during the evolution of orthograde man from his primitive arboreal stock, in order to render the foot able to take the body weight during standing and walking Atavistic anomalies of the foot are common, and recent work indicates that they are of importance in predisposing to such conditions as hallux valgus, metatarsalgia (Morton s disease), march foot (Deutschländer's disease), and Köhler Freiberg disease of the metatarsals

The Primary Anomaly In the pronograde foot of apes, adapted for prehension, the hallux is thumb-like, with a short metatarsal bone widely abducted in the varus position and very mobile in relation to the other metatarsals. During evolution towards the human form the hallux metatarsal becomes adducted towards the other toes, is fixed in position and equals the other metatarsals in length Coincidently it becomes thickened and strengthened, and as the longitudinal arch of the foot is developed, it takes a major part in supporting the body weight.

Quite commonly the first metatarsal presents a structural anomaly which may be regarded as an atavism the bone is abducted to the varus position (metatarsus primus varus) is relatively short and possesses an exaggerated mobility This anomaly tends to weaken the longitudinal arch of the foot. The weakness may be compensated by bony hypertrophy of the second metatarsal or by an increase of muscle tone (especially the adductor hallucis, which serves to fix the mobile first metatarsal, and the lumbricals and interossei, which keep the small toes in contact with the ground and so diminish the load on the metatarsal heads) If, however these compensatory mechanisms fail, as may occur from strain, over use, illness or malnutrition, increased strain is placed upon the forefoot and one or more of the following lesions may develop

Plantar Digital Neuroma (Metatarsalgia Morton s Disease) The term metatarsalgia includes two types of metatarsal pain. The first is of neuralgic character situated in the interval between two of the metatarsal heads. It is often due to a neuroma of one of the digital nerves in this situation Pressure on the neuroma, which may be 0 5 to 1 cm. in diameter causes pain referred to the toe and up the leg The treatment is to remove the neuroma through an incision on the plantar aspect.

The second type of pain is a constant one of burning character situated under the ball of the toes, and probably due to strain of the metatarsal arch. The treatment is to restore the tone of the muscles by exercises and electrical treatment. In some cases relief is obtained by supporting the anterior arch with an encircling adhesive plaster



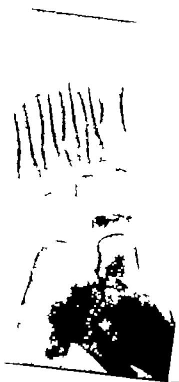
Hallux valgus. Note the abnormally short broad, mobile first metatarsal bone which is displaced in the varus position



Köhler Freiberg disease of seco metatarsal bone.



Deutschländer's disease of second metatarsal bone, with fracture



Köhler's disease of tarsal navicular

[To face p. 217

March Foot (Deutschländer's Disease) This interesting condition occurs in infantry recruits and hikers after unusually strenuous marching and in those such as nurses whose occupation entails much standing. It develops insidiously, with pain in the metatarsal region and oedematous swelling on the dorsum of the foot and leads to considerable disability. Radiography in the early stages may show little abnormal. Later there develops a spindle-shaped swelling of subperiosteal bone in the middle of the shaft of one of the metatarsals usually the second or third. Later the metatarsal shaft becomes decalcified and often sustains a transverse fracture. It is thought that the cause is a strain of the forefoot superimposed upon a metatarsus varus deformity which leads to bending of the delicate metatarsals during walking and thus to periosteal new bone formation. The treatment is to encircle the forefoot with adhesive strapping with a pad of sponge rubber on the plantar aspect.

AFFECTIONS OF THE TOES

Fracture of the Phalanges

This fracture may be caused by stubbing the toe or by a weight falling on the toe. There is little or no displacement except in the case of the proximal phalanx, when the toe tends to be dorsiflexed by the interosseus and lumbrical muscles. The treatment is to bind the toe with adhesive strapping for a week or two. In the case of the first phalanx of the great toe a splint or a strip of plaster bandage may be required.

Hallux Valgus and Bunion

These two conditions occur together so regularly that they can best be regarded as twin manifestations of a single disease. The deformity is a complex one, probably in part congenital though aggravated by the pressure of tight shoes.

Hallux valgus is almost confined to women. The foot is short, and very broad across the metatarsal region. The broadening is due to wide separation of the first metatarsal bone which deviates from the second metatarsal much in the same way as the thumb metacarpal deviates from its neighbour. This deformity (metatarsus primus varus) has been regarded as an atavistic trait. As a result, the direction of pull of the long tendons of the great toe is altered and the toe becomes displaced into the valgus position. It is possible that tight and fashionable footwear may play a part in this process, though its importance has been exaggerated. Certainly hallux valgus is common in women who are not slaves to fashion.

Bunion. The causative effect of tight footwear is much more evident in relation to bunion which results from long continued pressure on the prominence formed by the medial aspect of the head of the first metatarsal bone. In the course of time a dome like exostosis develops at this point, surmounted by an adventitious bursa.

Symptoms Uncomplicated hallux valgus may be symptomless. Usually the main complaint is of pain related to the bunion. This is not surprising for shoes of standard shape are far too narrow for the broad forefoot associated with hallux valgus, so pressure on the bunion is almost

inevitable. Sometimes there is pain from arthritis of the first metatarso-phalangeal joint. Sometimes there are painful corns on the outer toes which tend to be displaced by the hallux.

Treatment. In mild cases much relief is gained by having shoes made to measure. If this does not suffice, operation is indicated. Various



Fig. 118. Hallux valgus with bunion. The displacement of the long extensor tendons is clearly visible.

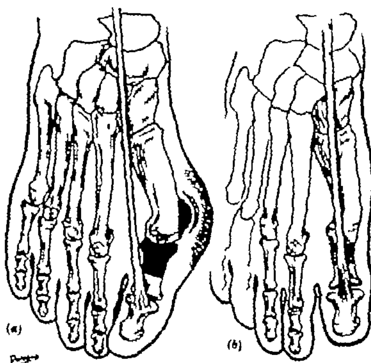


Fig. 119 Operation for hallux valgus. (a) The exostosis and the greater part of the first phalanx are removed. (b) The end result.

types of operation are in use, and each has its advocates It is generally agreed that if a bunion is present the exostosis and the overlying bursa must be removed Thus is done through a curved incision arching immediately above the prominence. The skin flap is turned down, the thick walled bursa dissected out, and the exostosis trimmed off with a chisel.



FIG 120 Bunion complicated by suppurative arthritis of the proximal joint of the toe and sloughing of the overlying skin.

Usually it is not sufficient simply to deal with the bunion In addition the valgus deformity must be corrected, either by removing part of the head of the metacarpal bone or by excising half the first phalanx. Thereafter the metatarso-phalangeal joint may be fused (arthrodesis) or the bones left with a gap between them in order to form a false joint. For this latter procedure the Keller technique (p 220) is most satisfactory

Hallux Rigidus

In this condition there is an arthritis of the metatarso-phalangeal joint of the great toe, with secondary stiffness from muscle spasm and later from fibrous contracture of the soft tissues.

Hallux rigidus occurs mainly in flat footed adolescents, and the arthritis is traumatic in origin, associated with the long foot and long toe seen with this deformity The term "rigidus" is a misnomer for the toe can be plantiflexed without difficulty but any attempt at dorsiflexion is acutely painful. Rarely in late cases, the toe is contracted towards the sole—hallux flexus.

Hallux rigidus is a painful and disabling affection The pain is caused by forcible dorsiflexion of the toe when taking-off" from the affected foot in walking and it is always increased by exercise. To mitigate the pain the foot is held rigid in walking and a clumsy ungainly gait results.

On examination, the stiffness of the toe is apparent. The metatarso-phalangeal joint is often swollen and the overlying skin is reddened, and perhaps irritated by the pressure of the shoe Marginal exostoses may be palpable on the dorsal aspect of the metatarsal head. In late cases there is a compensatory hyperextensibility ot the inter phalangeal joint.

Treatment. In a mild case relief may be given by fitting a rigid

steel plate in the sole of the shoe to protect the toe from being dorsiflexed. The shoe should be sufficiently roomy to avoid direct pressure on the inflamed joint.

If these measures fail Keller's operation may be advised which aims at forming a false joint after removal of half the first phalanx

A longitudinal incision is made on the dorso-medial aspect of the toe. The metatarso-phalangeal joint is identified and opened from the dorsal aspect. The distal end of the metatarsal and proximal part of the



FIG. 121 *Hallux rigidus, with compensatory flexibility of inter-phalangeal joint.* Note the swollen proximal joint, which is marked by the pressure of the stocking.

first phalanx are cleared by means of a periosteal elevator and levered into the wound The exostosis on the metatarsal bone is removed with a chisel. The shaft of the phalanx is then divided cleanly with a saw fully half the bone being removed When the wound has been closed the part is firmly bandaged and the whole foot and leg enclosed in a walking plaster so that the patient may become ambulant in a few days Alternatively some surgeons prefer to keep the patient in bed for

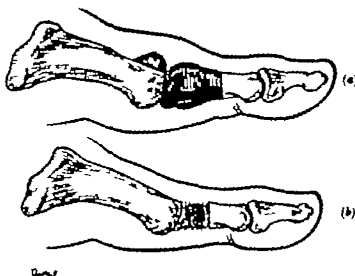


FIG. 122. Operation for hallux rigidus. (a) Proximal part of first phalanx removed and exostosis trimmed off. (b) The end result.

10–12 days, and during that time traction may be applied to the toe by a strong suture passed through the nail near its free border A weight and pulley may be used or the suture may be attached to a rod extending from a foot plaster case.

The gap left between the bones fills with fibrous tissue which forms a painless false joint. The toe shortens and in consequence is less liable to strain. At first it is flail but eventually it regains stability and strength

Instead of aiming at a false joint, some surgeons prefer to fuse the shortened phalanx with the metatarsal

Hammer Toe

In this deformity the toe is dorsiflexed at its proximal joint and acutely plantiflexed at its middle joint. The position of the terminal joint is variable.

In most cases the second toe alone is involved on one or both sides The deformity is generally attributed to contraction of the ligaments



FIG. 123. Hammer toe

on the plantar aspect of the middle joint of the toe. In some cases there is an inherited tendency though the contracture only becomes apparent in adolescence or adult life. Occasionally all the toes are involved in association with pes cavus or other deformities of the foot.

A hammer toe is subject to painful pressure by the boot on the dorsal

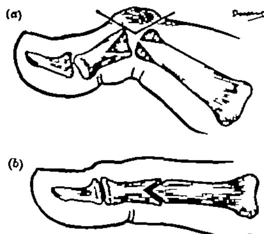


FIG. 124 Spike operation for hammer toe. (a) Ellipse of skin including corn and bursa removed. Bone ends trimmed. (b) Phalanges impacted.

aspect of the acutely flexed joint, and a bursa and a painful corn develop here. The bursa becomes inflamed and may even suppurate. Sometimes a second corn develops on the under aspect of the tip of the toe

Treatment. In early cases some relief can be obtained by manipulating the toe and fixing it by means of adhesive plaster strips applied as slings between the adjoining toes, one sling holding the first phalanx down the other holding the tip of the toe up In more severe cases operation is required. The operation is to excise an ellipse of skin, including the corn and bursa over the middle joint, and to remove the head of the proximal phalanx, so that the toe can be straightened. The two bones can be spiked together (Fig 124) or fixed by a stainless steel wire through the tip of the toe. If the first phalanx is much dorsiflexed, it may be necessary to divide the extensor tendon and the capsule of the proximal joint.

Onychogryphosis

This condition is most common in elderly people and affects the nail of the great toe most often. The nail is greatly thickened irregular horny and discoloured, and its distal part is separated from the underunderlying matrix. Pressure within the shoe causes pain and may lead to ulceration of the adjacent skin. In many cases the condition is a sequel to a fungus infection.

The treatment is to avulse the nail and resect the germinal matrix, that is to say that part of the nail bed which underlies the base of the nail and from which lengthwise growth of the nail proceeds.

The operation can be performed under local anaesthesia, injected as a ring block round the base of the toe. A tourniquet is applied to the toe The nail is avulsed Short incisions are made through the skin to enable the nail fold to be turned back. The germinal matrix is lifted off the periosteum and removed The skin flap is restored to position and stitched to the base of the " sterile matrix, that is to say the anterior part of the nail bed an epithelial structure which does not form new nail.

Ingrowing Toenail

This troublesome complaint is due essentially to the use of a tight shoe, which squeezes the soft tissues against the side of the nail.

The treatment in an early case is to provide a roomier shoe and a roomier stocking The patient should be instructed to cut the nail square across, for if the side of the nail is cut it becomes sharp and irritates the overgrowing skin The crown of the nail should be filed thin and softened by applying 5 per cent. salicylic acid in spirit to make it more pliable. In resistant cases operation is necessary The usual procedure is to resect a V-shaped piece of tissue, including about one-third of the nail, with its underlying matrix and the overhanging lateral skin fold If this is done, care must be taken to remove the whole of the germinal matrix concerned with the growth of that part of the nail

which is removed. In severe cases it is better to avulse the whole nail and remove the whole germinal matrix, as described under "onychogryphosis. If the skin under the nail edge is ulcerated or infected the nail should be avulsed as a first stage, and the remainder of the operation delayed for a month.



FIG. 125. Ingrowing toenail. The lines of incision are indicated.

Subungual Tumours

The commonest subungual tumour is an exostosis. This is an outgrowth of cancellous bone which forms on the dorsal surface of the terminal phalanx, generally of the great toe. It presses on the under surface of the nail and causes much pain The diagnosis is confirmed



FIG 126. Subungual exostosis.

by radiography The treatment is to remove the tumour along with the distal part of the terminal phalanx, by an incision around the distal part of the toe, parallel to the nail margin

Plantar Warts and Callosities

A wart, probably infective in origin, sometimes develops on the weight bearing area of the sole of the foot. Lying deep to the thick horny epidermis, it grows inwards, hollowing out a cavity in the sensitive dermis. It is consequently a very painful lesion extremely tender on weight bearing

Many methods of treatment have been tried, corn plasters, CO_2 snow salicylic acid X ray therapy The most satisfactory is, under general anæsthesia, to shave off the horny covering of epidermis and remove the soft corn with a curette. A disc of adhesive felt, with a central hole, is then applied in order to relieve pressure.

Extensive callosities are apt to develop especially under the metatarsal heads in persons with highly arched feet. They cause much pain on standing or walking The skin should be softened by frequent hot baths and by applications of 5 per cent. salicylic acid in spirit, and protected by adhesive felt or pads In severe cases the callosities should be pared with a razor

CHAPTER 22

THE SKULL AND BRAIN

THE SCALP

Wounds of the Scalp Wounds of the scalp are generally caused by a blow with a blunt object, which splits the scalp against the skull The wound in such cases is linear and cleanly cut as though made with a sharp knife. Less often wounds of the scalp are caused by sharp objects, e.g a weapon or a sharp glass edge.

If the wound is superficial, the skin edges are held in position by their firm attachment to the subjacent tissues, and it may then be missed, especially in women, if concealed by the hair If, on the other hand, the galea aponeurotica is divided the wound gapes widely

Hæmorrhage tends to be severe in scalp wounds, for the scalp is highly vascular and the cut ends of the blood vessels are prevented from retracting by their adhesion to the dense subcutaneous tissue in which they lie. The bleeding can be arrested in an emergency by firmly compressing the wound edges against the skull Later it can be secured permantly by sutures inserted through the whole thickness of the scalp

The further treatment of a scalp wound is to shave and purify the adjacent skin and to cleanse and excise the wound edges. Except in small superficial wounds, general anæsthesia is to be preferred. While the wound is open the skull should be examined carefully for signs of fracture. Finally the wound is closed by deep silkworm gut sutures, with drainage for twenty four hours unless complete asepsis can be presumed.

Avulsion of the Scalp. Formerly the scalp was liable to be avulsed in women mill-workers when the hair was caught in rapidly moving machinery Sometimes the whole scalp is torn off. Modern factory regulations, requiring close-fitting caps to be worn have rendered this a rare type of accident. The treatment is to cleanse any part of the scalp left and replace it in position Owing to the free anastomosis in the scalp a portion almost completely detached may yet survive. Any deficiencies are made good by skin grafts.

Hæmatoma of the Scalp A hæmatoma of the scalp may be subpericranial or subaponeurotic. The former is the cephalhæmatoma of infancy which results from an injury sustained during an instrumental delivery The pericranium is attached to the cranial suture lines, and consequently the hæmatoma is confined to the area covering a single bone. The treatment is to apply a firm bandage. If the hæmatoma is large it may be aspirated.

A subaponeurotic hæmatoma results from an injury to the scalp or from a fracture of the skull. The blood distends the lax connective tissue deep to the galea aponeurotica, and forms a large, soft, fluctuant swelling which may gravitate towards the eyebrow, the zygoma or the

occiput The blood may clot in its peripheral portion while remaining fluid over the convexity of the skull. If there is much fluid, it may be aspirated, but apart from this no treatment is required unless sepsis supervenes.

Cirsoid Aneurysm of the Scalp This is a pulsating mass of dilated blood vessels, intertwined in racemose fashion in the deeper layers of the scalp It may be congenital or traumatic in origin. The lesion gives rise to a loud subjective bruit, which may be very distressing The bruit may be heard on auscultation.

The treatment is described on p 81

Suppuration under the Scalp Suppuration under the scalp is not common but may result from an infected scalp wound Occasionally it follows osteomyelitis of one of the bones of the skull, or even infection of a hair follicle or sebaceous cyst. If the infection gains access to the space under the galea, the pus spreads widely forming a thin layer of fluid over the surface of the skull. In many cases there is severe toxæmia. If untreated, the infection may spread by an emissary vein and give rise to an extradural abscess, or even meningitis or sinus phlebitis. The treatment is to drain widely through multiple incisions in the scalp



Fig 137 Large sebaceous cyst (wen). The man's father and two brothers had suffered from multiple sebaceous cysts.

Sebaceous Cysts of the Scalp, Wens. Wens are common in the scalp and are often multiple. They are attached to the skin and move freely with the scalp They often attain large size, and they may become infected and suppurate. The treatment, in an uncomplicated case, is to shell out the cyst under local anæsthesia. This is best accomplished by bisecting the cyst and avulsing the halves in turn. A suppurating cyst should be incised and drained.

Sebaceous Adenoma of the Scalp This is a rare tumour It grows slowly and forms a rounded mass, covered with thin purplish skin Sooner or later the skin ulcerates and a cauliflower like mass fungates. The tumour is to be diagnosed from a rodent ulcer and from an infected wen The treatment is by excision



Fig. 128. Sebaceous adenoma of scalp.

Dermoid Cyst of the Scalp A dermoid cyst occurs most often above the lateral canthus of the eye (Fig 129) or near the midline of the skull It is present at birth, but may not be recognised until adolescence when it tends to increase in size. The cyst forms a palpable swelling of doughy consistency It is attached to the bone but not to the skin, and may have a deep connection with a cyst lying in the extradural tissues. In such cases symptoms of increased intracranial pressure may be caused The treatment is to excise the cyst.

Fig 129. Dermoid cyst, in a woman aged 53 who had been aware of the swelling for many years. It communicated by a small *aperture in* the skull with a loculus in the extradural space.



FRACTURES OF THE SKULL

Fractures of the skull owe their chief importance to the brain injury with which they are commonly associated In addition, if compound, they are important as predisposing to intracranial suppuration

Fractures of the Vault of the Skull

The vault of the skull may be fractured by direct or indirect violence. In the former case the injury is generally caused by a blow with a small object, and the fracture is situated at the point of impact and is often compound In the latter case the injury is generally caused by a fall on the head, and the fracture results from either 'bending or bursting of the elastic skull such a fracture is of the fissured type, and often is an extension from one involving the base of the skull. It is important to note that the inner table may be fractured more extensively than the outer in slight injuries the inner table may be splintered though the outer one remains intact.

Types of Fracture. *A Fissured Fracture* may be simple or compound, and it varies in degree from a slight crack to a split extending right across the vault. The fracture itself causes no symptoms, and, if the skin is unbroken, it can only be diagnosed with certainty by radiographic examination If a scalp wound is present, the fracture is recognisable as a linear crack, often with one edge slightly raised as a palpable ridge.

A Punctured Fracture results from a blow by an object of small size. It is generally compound Often the missile is driven through the bone and dura mater into the brain, perhaps carrying infective foreign material with it. A portion of the bone may also be driven in. Infective complications such as meningitis or brain abscess are common

A Depressed Fracture is caused by direct violence, e.g a severe blow or a kick by a horse. The bone at the point of impact is fractured into two or three fragments, which are driven in towards the brain. The dura mater is liable to be torn. The fracture is apt to give rise to symptoms by pressing on the brain or more important, by causing local œdema of the brain. If as often happens, it is compound, there is the added risk of infection.

In young children there is a special type of depressed fracture, the 'pond fracture, in which the soft skull sustains a greenstick fracture and is indented like a celluloid ball.

Treatment. In simple fissured fractures no special measures are required, apart from rest in bed for two or three weeks An associated brain injury must be treated

Operation is indicated in two types of fracture of the skull (1) in all compound fractures (2) in nearly all depressed fractures

In compound fractures immediate operation should be performed. The scalp is shaved and the wound thoroughly cleansed (p 225). The fracture it then inspected and, if it is contaminated, the bone edges

should be removed with nibbling forceps The wound is then closed preferably with drainage for twenty four hours. If the fracture is of the punctured type, sufficient bone must be removed by trephine, or a bone flap may be elevated to expose the damaged brain. Loose fragments of bone and foreign matter are then removed, the dural wound is sutured and the wound closed with drainage.

In simple depressed fractures operation should be performed if there are any symptoms indicating pressure on the cortex. In children operation is generally unnecessary, as the soft skull does not tend to cause pressure symptoms The operation consists in exposing the fracture through a suitable incision and elevating the depressed fragments. If necessary, a trephine opening may be made through healthy bone close to the fracture, so that an elevator can be introduced under the fragment.

Fractures of the Base of the Skull

In the great majority of cases fracture of the base of the skull is caused by indirect violence, as a result of a fall on the head. Since the skull is slightly elastic, it " gives " a little, and is flattened in the direction of the injury The base, however being less elastic and more rigid than the vault, resists distortion and is fractured In most cases there is an extensive fissure, disposed more or less transversely across the base, and often extending to the vault.

Less commonly a fracture of the base results from a fall in the sitting position, when the violence is transmitted by the spinal column and the bone gives way close to the foramen magnum. Even more rarely the base of the skull is fractured by the impact of one of the condyles of the mandible, as a result of a blow on the chin.

In contrast with these forms of fracture due to indirect violence, there is the rare fracture, limited to the anterior fossa, resulting from direct violence, by a small missile or weapon entering *via* the orbit, the nose or the pharynx. In such cases there is a grave risk of infection, especially if a foreign body is carried in.

Clinical Features. A fracture of the base of the skull may give rise to no symptoms, and can then only be diagnosed with certainty by radiographic examination, though it can often be suspected from the nature of the injury and the symptoms and signs of associated brain damage.

In other cases the following signs may appear depending on the site of the fracture —

Fracture of the Anterior Fossa. (a) Bleeding, sometimes with escape of cerebrospinal fluid from the nose or bleeding into the orbit. The orbital hæmorrhage, which retains its bright red colour from oxygenation through the conjunctiva, appears first under the conjunctiva at the lateral margin of the eye, and then spreads fanwise towards the cornea. Later swelling and purple discoloration may spread to the eyelids in a characteristic monocle distribution

(b) Injury to any of the first six cranial nerves, especially the first and sixth

Fracture of the Middle Fossa. (a) Bleeding sometimes with discharge of cerebrospinal fluid, from the ear through a rupture of the tympanum

(b) Injury to the seventh or eighth nerve.

Fracture of the Posterior Fossa Bruising in the upper part of the neck appearing about the third day



FIG. 130 Fracture of supra-orbital margin with subconjunctival hæmorrhage.

Complications. A fracture of the orbital plate often tears the dura mater of the anterior fossa where it is anchored by the olfactory nerves. A channel is thus opened from the nostril into the subarachnoid space, with grave risk of meningitis. There is a similar risk in a fracture involving the pharyngeal vault. Meningitis may develop at once, or subsequently as a result of a cold frontal sinusitis, etc.

Other complications are due to associated damage to the brain or cranial nerves.

Treatment. A fracture of the base of the skull if uncomplicated requires no special care, though any associated brain injury naturally may demand its own special treatment.

If however, the fracture is associated with leakage of cerebrospinal fluid into the nose of pharynx, active treatment is required, for a tear of the dura mater is very slow to heal and will admit infection to the meninges. Antibiotics should be administered at once. As soon as the general condition permits, operation is performed. A forehead flap is turned down to expose the anterior fossa, and the torn dura is sutured or protected by a postage stamp fascial graft.

INJURIES TO THE BRAIN

The brain may be injured in association with a fracture of the skull, but some of the most severe brain injuries occur when the skull remains intact. Apart from direct wounds, the brain damage results from sudden displacement of the brain within the skull. There may be an "acceleration injury" due, for example, to a blow on the head or a "deceleration injury" due to a fall from a height.

In the slightest forms, there is a simple concussion due to "molecular disturbance" of the brain without gross pathological changes. In the more severe forms there are contusions and lacerations of the brain which are generally multiple. They occur most often at the point of impact and at the point of "contre-coup" diametrically opposite, and also occur at the points where the soft brain tissue impinges against the tentorium and the falx cerebri. The destruction of nerve cells is not in itself so extensive as to cause paralysis, and the symptoms are mainly due to the small hæmorrhages and the extensive œdema to which they give rise.

Occasionally the clinical course of a head injury is complicated by subdural or extradural hæmorrhage.

Examination of the Case In all cases of head injury an accurate history should be obtained if possible, both of the accident and of the patient's previous health and habits.

On examination first the depth of unconsciousness is gauged by noting the character of the respirations and by attempting to question the patient. Next the head is examined carefully for a wound or a hæmatoma under the scalp and the skull is palpated for evidence of a fracture. Bleeding under the conjunctiva or from the nose or ear must be noted

The pulse, temperature and respiratory rate are recorded and the blood pressure should be estimated. The pupils are examined and, preferably the discs should be viewed

Next the face is inspected carefully for evidence of facial paralysis In partial paresis the only sign may be slight flattening of the naso-labial fold

The limbs are then examined, and each is lifted from the bed and allowed to fall, so as to estimate the muscle tone and thus obtain evidence of paralysis. The reflexes must be tested. Finally the examination is completed by radiography

Throughout the examination the possibility of other injuries must be borne in mind In the unconscious patient it is possible for a fracture of the spine or a ruptured spleen to be missed

Clinical Features. In a slight concussion the period of unconsciousness is brief

Recovery is heralded by vomiting which may be repeated. Then the temperature rises and remains elevated a degree or so for a few days. The pulse during the reaction phase is full and bounding but later it is persistently slow

Return to health is rapid except that there may be permanent amnesia for the events immediately prior to the accident, although the memory for earlier events is quite unimpaired

In more severe cases the unconsciousness is deeper and more prolonged. On recovering the patient passes into the state of "cerebral irritation" and lies curled up, on his side, and resists all interference. When disturbed he quickly resumes his original position. He avoids the light, turns his back to the window and keeps his eyes tightly

closed He is stuporose, but can be made to respond though curtly and irritably *to firm questioning* The pulse is slow small and weak. Respiration is slow and shallow

This phase may last as long as two or three weeks. Complete return to normal is then a slow process, and for months there is a liability to recurrent headaches. The sequelæ described below (p 285) are not uncommon.

If the injury is still more severe, the coma deepens, with stertorous breathing due to paralysis of the palate. The pupils become unequal and there may be paralysis *of a limb Spasticity of the limbs* is a sign of grave import.

Diagnosis. The diagnosis is to be made from the following conditions —

(1) Coma, uræmic or diabetic. Examination of the urine provides valuable evidence.

(2) Hæmorrhage into the brain—an apoplectic stroke. The diagnosis is suggested by the age of the patient, the condition of his blood vessels, and the early occurrence of hemiplegia. There may be a history of a previous attack.

(3) Alcoholic intoxication. It must be remembered that brandy *is often administered as a first-aid measure in concussion cases, so no* reliance can be placed upon a smell of alcohol in the breath. In alcohol poisoning examination of the gastric contents gives valuable information, and gastric lavage also brings about a rapid improvement.

(4) Opium poisoning The unconsciousness may be profound. The pupils are contracted to pin points and do not react to light. Respiration is very slow and shallow There may be hypodermic needle punctures. If the opium has been taken by mouth it may be demonstrated in the gastric contents, while gastric lavage with potassium permanganate may bring relief if the condition has not progressed too far

(5) *Epilepsy The coma after a fit may simulate concussion,* especially if in falling the epileptic has sustained a scalp wound The history of previous fits provides the essential clue.

Treatment. The patient must be kept quiet and at rest in a darkened room and under close observation. The pulse and temperature should be taken two-hourly and any change in the condition, especially any sudden slowing of the pulse, must be reported at once.

In slight concussion, when consciousness returns, the patient must be pressed to stay quietly and at rest, for a period varying from one to three weeks, to diminish the liability to recurrent headaches. Even reading should be prohibited to secure complete mental relaxation.

In more severe cases, where the unconsciousness persists or deepens, expert opinion is divided. Some recommend active measures to reduce intracranial tension, such as administering hypertonic solutions or making multiple burr holes in the skull. Others have given up these methods and advise purely conservative treatment, designed to prevent complications and maintain life until the bruised brain recovers. Respiratory

complications are most common, due to impaired cough reflex and consequent inhalation of pharyngeal contents or vomit. The resulting hypoxia causes further brain damage. In prolonged coma pressure sores may develop and retention of urine is a further complication The patient must be nursed semi prone and turned frequently He may need intra gastric feeding If the cough reflex does not return quickly some surgeons recommend a tracheotomy using a rubber tube with inflatable cuff to prevent inhalation of vomit. Bronchial suction is applied frequently and oxygen administered It is possible that in the most severe cases treatment by refrigeration may be helpful

Extradural Hæmorrhage
(Middle Meningeal Hæmorrhage)

Extradural hæmorrhage is usually due to injury to the anterior branch of the middle meningeal artery by a fracture involving the temporal bone. Occasionally other vessels are affected in the same way such as the posterior branch of the artery or one of the venous sinuses. Bleeding takes place slowly partly because the blood pressure initially tends to be low as a result of shock, and partly because the dura mater is densely adherent to the bone. Consequently the effects of extradural hæmorrhage are delayed.

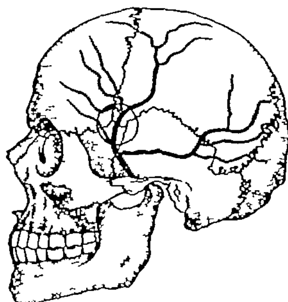


FIG. 131 Middle meningeal artery The circle indicates *pterion*, the common site of *extradural hæmorrhage*.

Clinical Features. Characteristically the course of events is divisible into three stages (1) the concussion phase (2) the lucid interval (3) the compression phase. The concussion may be slight or severe. During this phase the hæmorrhage does *not progress*, owing to the reduced blood pressure. After consciousness is regained, recovery appears to be *progressing normally* and there is a lucid interval, which lasts perhaps an hour or exceptionally for a day

The later symptoms are those of increasing intracranial pressure

with focal signs due to pressure over the motor cortex. The earliest focal sign is usually facial paralysis—a paresis affecting the lower part of the face and visible as a slight asymmetry of the naso-labial fold. Later this paralysis becomes more marked and the arm and leg also may be affected In some cases twitchings of the affected muscles precede the onset of paralysis. Usually the paralysis occurs on the side opposite to the hæmorrhage. Occasionally however a large hæmorrhage displaces the brain and causes pressure on the opposite motor pathway and then bilateral paralysis results

At first the patient is restless and excited, then drowsy and eventually comatose The temperature is subnormal at first, but later tends to rise, and terminally may be very high. The pulse is typically full and slow with a raised blood pressure due to stimulation of the vasomotor centre—the compression pulse. Respiration becomes stertorous owing to paralysis of the palate. The pupils are unequal in size and do not react to light. The discs are congested and there may be slight papill œdema. In the final stages the coma deepens, the pulse becomes rapid irregular respiration assumes the Cheyne-Stokes rhythm, and paralysis of the vital centres in the medulla causes death.

Diagnosis. It must be emphasised that in the early stages, during the lucid interval there are no characteristic features, and the diagnosis can only be made after careful, repeated observation with particular attention for signs of facial paresis. A middle meningeal hæmorrhage is rarely the sole lesion, and in most cases the clinical picture is complicated by widespread œdema due to multiple lacerations of the brain.

The diagnosis has to be made from such a condition, and also from the affections described in the diagnosis of concussion. The most significant features are the history of a lucid interval and the occurrence of increasing compression with evidence of focal pressure on the motor cortex.

Treatment. Every case of concussion however slight, must be kept under careful observation for twenty four hours, lest middle meningeal hæmorrhage develop No such case should be refused admission to hospital. When the evidence points to hæmorrhage, the treatment is to expose the bleeding point and evacuate the clot. Evidence of the probable site of hæmorrhage may be obtained from study of the course of the fracture line as seen on X ray examination. Most often the hæmorrhage is from the anterior branch of the artery and the trephine opening should be made over this vessel at a point 4 cm above the zygoma and 3 cm. behind the external angular process of the frontal bone. If no hæmatoma is found here, a second trephine should be made over the posterior branch of the artery at a point roughly ½ inch above and behind the Darwin s tubercle of the auricle. Occasionally it is necessary to trephine both sides of the skull.

When the clot has been found and evacuated the bleeding which is rarely more than a slight ooze, is arrested by pressing a postage-stamp graft of muscle against the wounded vessel. If this fails, the

artery may be under run by a silk stitch The wound is then closed with drainage for twenty four hours.

An alternative procedure favoured by skilled neuro surgeons is to perform a wide exploratory craniotomy, and having dealt with the extradural clot, to open the dura, with the object of affording decompression for the brain which in such cases usually presents extensive œdema.

After-effects of Head Injuries

Any head injury more than a very slight concussion is liable to untoward sequelæ.

Headache occurs in almost 50 per cent. of cases unless treatment is thorough at the time of the injury The headache tends to persist and recur for a long time. It can only be prevented by insistence upon prolonged rest after the original injury and it is a wise precaution to insist, in all but the most trivial injuries, upon absolute rest in bed for one to three weeks or even more, with prohibition of reading to afford complete mental relaxation.

Traumatic Neurasthenia may follow more severe injuries It is characterised by an alteration of the mental attitude, with instability incapacity for intellectual effort, and attacks of excitement alternating with depression. The treatment is by prolonged rest in bed in quiet, surroundings. In severe cases epilepsy or even insanity may occur

Complications due to nerve lesions may occur including glycosuria, polyuria (from damage to the hypothalamic region), loss of sight, hearing or smell.

Chronic Subdural Cyst is due to a hæmorrhage into the subdural space. The blood clots and later liquefies forming a cyst which tends to increase in size, causing pressure symptoms.

INTRACRANIAL SUPPURATION

Like other infective processes, the various forms of intracranial suppuration have lost their former importance and are now neither common nor dangerous. Brief consideration will therefore suffice.

Extradural Abscess. An abscess may form between the dura mater and the bone under a compound fracture of the skull, or it may occur as a complication of middle ear disease. It gives rise to general toxic effects and to local pain A classical sign of bygone days was "Pott's puffy tumour which was merely local swelling due to œdema of the scalp over the abscess. In treatment, if antibiotics fail to bring about a cure the abscess must be opened In a case of compound fracture, the wound is reopened and loose or softened fragments of bone are removed to give access.

Brain Abscess. Formerly abscess in the brain was dreaded as a dangerous and often fatal complication of middle ear disease. In such circumstances the abscess was caused by direct spread of infection from

the ear and was located either in the temporal lobe or the cerebellum

A quite different type of abscess occurred as a complication of septic diseases in the thorax such as bronchiectasis and chronic empyema, and was attributed to blood borne infection.

Usually the abscess *pursues a chronic course*, leading to impaired cerebration but no localising signs. The treatment is by operation In some cases the abscess is thick walled and can be shelled out like a tumour

Sinus Phlebitis. Infection of the lateral venous sinus was one of the most dreaded complications of middle ear disease, while infection of the cavernous sinus was a rare but almost always fatal complication of facial carbuncle. The infected sinus filled with soft purulent blood clot, and *caused pyæmia through the spread of emboli*, while meningitis also was apt to develop

HYDROCEPHALUS

Hydrocephalus results from an obstruction to the flow of cerebrospinal fluid. Normally the fluid is secreted by the choroid plexuses mainly in the lateral ventricles, passes thence through the third and fourth ventricles through the foramina in the roof of the fourth ventricle and thus into the cisterna magna. It then seeps over the surface of the brain and is absorbed into the large venous sinuses *The obstruction may occur at any point in the path of the* fluid most commonly at one of the following points: (1) the aqueduct of Sylvius (2) the roof of the fourth ventricle (3) the narrows of the subarachnoid space where the midbrain is gripped by the tentorium cerebelli

Hydrocephalus in Infancy Hydrocephalus in infancy may be associated with gross defects in the development of the brain and is then usually fatal at an early age. In other cases the hydrocephalus is associated with spina bifida. It may then remain latent, owing to the safety valve effect of the spinal protrusion and only become manifest when the latter defect has been repaired. Finally there is a third class of case, in which the hydrocephalus is due to the obstructive effect of adhesions resulting from a low-grade meningitis sometimes syphilitic. Such adhesions often obstruct the cerebrospinal fluid by obliterating the foramina in the roof of the fourth ventricle.

The clinical features are characteristic. The accumulation of fluid within the ventricles leads to a globular enlargement of the skull. The fontanelles bulge, and the bones, thinned almost like parchment, are widely separated. The eyes are displaced downwards and strabismus is common.

The diagnosis is evident. The site of the obstruction may be determined by ventriculography (p 240)

The treatment is palliative in the great majority of cases If the site of obstruction is at the roof of the fourth ventricle, operation may be advised with the object of dividing the adhesions and forming a new aperture into the ventricular system. Alternatively a rubber tube may be inserted to drain the lateral ventricle into the basal cisterna

Hydrocephalus in Childhood and Adult Life. After infancy hydrocephalus is generally due either (1) to the pressure of a tumour in the posterior fossa, e.g an acoustic neuroma pressing on the pons and compressing the aqueduct of Sylvius or (2) to adhesions in the subarachnoid space secondary to cerebrospinal meningitis.

Since the skull cannot expand, the ventricular distension takes place entirely at the expense of the brain and the intracranial tension is greatly increased. As a result, intense headache, vomiting of the cerebral type and marked papillœdema are prominent symptoms

INTRACRANIAL TUMOURS

The following intracranial tumours will be described —

(1) The glioma group glioma, gliosarcoma, sarcoma.
(2) Meningioma (dural endothelioma)
(3) Acoustic neuroma.
(4) Pituitary tumours.
(5) Miscellaneous tumours, including metastatic tumours, and also the granulomata of tuberculosis and syphilis.

The Glioma Group

The tumours formerly called glioma, gliosarcoma and sarcoma are now known to arise from the neuroglia, the supporting framework of the brain. They should not be regarded as distinct types of growth, but as members of a single series varying only in degree. As in the case of all neoplasms, their microscopic character varies according to the malignancy and the more rapid the growth the greater the degree of reversion towards an embryonic type of cell. Thus the slowly growing simple glioma, which reproduces adult glia cells—small star shaped cells known as astrocytes—is called *Astrocytoma* the rapidly growing "gliosarcoma, which reproduces primitive glia cells—large fusiform, spongy cells known as spongioblasts—is called *Spongioblastoma* and the equally malignant "sarcoma," which reproduces another primitive type of cell—a round cell known as the medulloblast—is called *Medulloblastoma.*

These tumours give pressure effects depending on their site of origin. They can be diagnosed on clinical grounds or by X rays, ventriculography and cerebral angiography In the more benign types the tumour can be removed, or if extensively cystic it can be aspirated. X ray therapy is useful and decompression mitigates the effects of increased intracranial tension

Meningioma

This is a benign tumour microscopically resembling an endothelioma, which arises from the arachnoid mater and grows slowly into the cranial cavity indenting the brain, but not invading it. In some cases it invades the bone of the skull.

Since the tumour grows slowly it may attain considerable size, yet cause few symptoms. It may cause localised pain in the head, an ocular palsy or epileptiform attacks. Eventually the signs of increased intracranial tension appear

The diagnosis is confirmed by X ray examination which shows erosion of the skull over the tumour and widening of the vascular grooves due to the increased vascularity

The treatment is by operation. The skull is opened by a wide bone-flap exposure, and if the tumour is accessible it may be shelled out from its nest in the indented brain and removed. If the tumour is not

cessible, the greater part of it may be removed by the fulgurating ectrode.

Acoustic Neuroma

This is a simple neurofibroma of the eighth nerve. It lies close to e internal acoustic meatus, below the tentorium cerebelli, in the gle between the cerebellum and the pons. It is sometimes bilateral d often associated with neuromata of the peripheral nerves. It grows wly and its main effect is to press upon the eighth nerve, causing ilateral deafness and sometimes tinnitus.

The treatment is by operation. A suboccipital exposure is performed, e nuchal muscles being elevated and much of the occipital bone moved. The dura mater is opened and the cerebellum is gently located to display the site of the tumour Complete excision of the mour is rarely attempted, owing to the risk of severe hæmorrhage m large arteries in its capsule, but a subcapsular resection by means the fulgurating electrode gives prolonged relief

Tumours of the Pituitary Gland

Nearly all pituitary tumours are benign adenomas arising from the terior lobe.

The *chromophobe adenoma*, so called because it contains no eosin ining granules, causes pressure effects, of which the most notable is temporal hemianopia, and gives rise to signs of hypopituitarism, uch include atrophy of the sex glands with amenorrhœa or impotence, s of hair adiposity of the Fröhlich type (dystrophia adiposo-genitalis) d increase in sugar tolerance

The diagnosis of this type of tumour is assisted by radiography uch reveals ballooning of the sella turcica.

The treatment is by operation, if there is evidence of pressure on the iasma, in order to avert complete blindness. Access is usually gained the transfrontal route after elevating a frontal bone flap

The *Chromophil Adenoma*. This differs from the chromophobe mour in that some of its cells contain chromophil (eosinophil) granules d secrete a hormone. It gives rise to pressure effects similar to those scribed above, and to the secretory effects characteristic of hyper uitarism. In adults there is acromegaly in adolescents gigantism.

The treatment is the same as for the chromophil tumour

The *Basophil Adenoma*. This tumour is entirely different from ose described above. It is a small growth, often microscopic, and it uses no pressure effects. It gives rise to symptoms (Cushing's syn ome) in virtue of its hormones, which act by influencing the activity the adrenal cortex (see p 461)

Miscellaneous Intracranial Tumours

Angiomata may take the form of dilated vessels over the surface of the misphere, or solid tumours within the brain substance. In the former se there are signs of cortical irritation and there may be an audible bruit. the latter case the symptoms are similar to those of a glioma.

Pineal Tumours may occur in childhood. They may cause an alteration in the sexual characters and are apt to lead to an early fatal issue by causing internal hydrocephalus

Suprasellar Epidermoid Tumour (Cranio-pharyngioma) This rare cystic tumour is believed to arise from vestiges of the cranio-pharyngeal canal the embryonic outgrowth which is responsible for the formation of the anterior lobe of the pituitary The tumour originates in childhood but enlarges slowly and generally comes under notice in adult life It lies above the pituitary gland and gives rise to pressure effects on the upper posterior part of the optic chiasma and to polyuria.

Metastatic Tumours may occur secondary to carcinoma of the bronchus breast, stomach or other sites. Such growths are generally multiple. They may give rise to irritative phenomena and convulsions or to paralysis.

Tuberculomata are nodules of tuberculous granulation tissue which may attain the size of a walnut. They are generally multiple and are attached to the meninges. They occur most often in children in the posterior fossa of the skull Occasionally a tuberculoma is solitary and gives rise to symptoms very similar to glioma from which it can with difficulty be diagnosed.

Diagnosis of Brain Tumours

The diagnosis of brain tumours must rest upon meticulous clinical examination supported by a variety of accessory tests, including ophthalmoscopy perimetry examination of the cerebrospinal fluid and such radiological investigations as ventriculography encephalography and cerebral angiography

The Cerebrospinal Fluid. There is a certain risk involved in performing lumbar puncture in cases of brain tumour for withdrawal of the fluid may lead to impaction of the brain in the foramen magnum.

In early cases of brain tumour the fluid may show no abnormality In later cases the pressure may be raised (a pressure over 200 mm of water with the patient recumbent, is significant) or there may be an excess of protein above the normal of 50 mg per cent. An increase in the globulin fraction is especially significant. The presence of blood in the fluid is unusual in cases of tumour and rather suggests an intracranial aneurysm. Similarly the presence of an excess of cells, over the normal figure of four lymphocytes per c.mm. suggests a meningitis.

In addition to these features, the Wassermann reaction of the fluid must be tested, while the chloride and sugar content and the gold precipitation curve may give useful information

Radiography Much useful information may be gained by simple stereoscopic radiography of the skull.

Certain tumours, such as the suprasellar cystic tumour may show calcification in their capsules, while others, such as the meningioma, cause erosion of the overlying inner table. Pituitary tumours enlarge the sella turcica, while an acoustic neuroma may enlarge the internal acoustic meatus. The pineal body which is frequently indicated by faint calcification in the adult, may be displaced by a space-occupying lesion in one side of the skull. Evidence of increased intracranial pressure may be seen in decalcification of the clinoid processes or in general thinning of the inner table

Encephalography This is a radiographic method of outlining the

ventricles by air introduced *via* the spinal canal. A lumbar puncture needle is inserted, with the patient seated, cerebrospinal fluid is withdrawn in small quantities and a corresponding or slightly smaller amount of air is introduced The amount injected varies from 5 ml. to 50 ml. The air ascends and most of it passes into the ventricles, while a small portion diffuses over the surface of the brain and in the subsequent radiographs outlines the cerebral gyri.

Ventriculography By this method air is introduced directly into the ventricles. It is of value in the diagnosis and localisation of obscure tumours, and is also useful in hydrocephalus. It is not free from risk (see below)

In adults the procedure is to trephine the skull through two small incisions, placed on either side, 4 cm. from the midline and about 9 cm. in front of the occipital protuberance. A special blunt needle is then introduced into the posterior horn of each lateral ventricle. Fluid is removed from one ventricle and replaced by air injected into the other Radiographs are then taken with the patient in various positions, so as to demonstrate each of the ventricles in turn. In infants the procedure is similar but the needle is introduced through the skin at the lateral angle of the anterior fontanelle.

Both encephalography and ventriculography may cause symptoms of acute increase of intracranial pressure and necessitate an emergency decompression. They should therefore be carried out only by experts.

Cerebral Angiography In this method the internal carotid artery is exposed in the neck, and 10 to 20 ml. of diodrast are injected through its wall A radiograph taken within a few seconds of the injection outlines the intracranial vessels and may demonstrate displacement of the vessels or show up a highly vascularised tumour

INTRACRANIAL ANEURYSMS

Two quite distinct types of aneurysm occur within the cranium, the congenital aneurysm of the cerebral arteries, and the acquired aneurysm of the internal carotid artery

Aneurysm of the Cerebral Arteries. This type of aneurysm occurs in any of the arteries related to the arterial circle of Willis. It is situated most often close to the termination of one of the internal carotid arteries. The aneurysm arises as a result of a congenital weakness in the arterial wall, and may give rise to symptoms either in childhood or more often, in early adult life.

The symptoms are generally due to leakage of blood into the subarachnoid space—the so-called spontaneous *subarachnoid* hæmorrhage. There is a mild apoplectic seizure, followed by severe headache, and in most cases an ocular paresis. Several such hæmorrhages may occur and finally a more severe one may prove fatal.

The diagnosis is confirmed by finding blood in the cerebrospinal fluid. The site of the aneurysm may be demonstrated by arterial

radiography, a radiogram being taken immediately after the injection of an opaque fluid such as Diodrast into an internal carotid artery exposed in the neck.

Operation is carried out under hypothermia In some cases it is possible to expose the aneurysm and apply a silver clip to its stalk, or to the artery on each side of it. In others, the internal carotid artery may be ligated in the neck (see below)

Aneurysm of the Internal Carotid Artery, Pulsating Exophthalmos. This aneurysm generally results from a fracture of the middle fossa of the



FIG. 182. Arteriogram showing congenital aneurysm of circle of Willis.

skull. In many cases it is of arteriovenous type, with a communication between the aneurysmal sac and the cavernous sinus.

The aneurysm gives rise to the condition of pulsating exophthalmos. The eyeball is displaced forwards and the conjunctivæ and orbital tissues are congested and œdematous. In some cases there is a visible pulsation of the orbital contents, synchronous with the heart beat, and there may be a thrill felt on palpation over the orbit, while auscultation over the temporal region reveals a loud systolic bruit.

The patient experiences a *roaring, beating sensation, with frequent* headaches and constant distress.

Pulsating exophthalmos may also be caused by an aneurysm of the ophthalmic artery and vascular tumours such as an angioma or even a rapidly growing sarcoma.

The treatment in most cases is to ligate the internal carotid artery in the neck. This results in immediate cessation of the pulsation, and though, owing to the development of a collateral circulation, there is

some recurrence in a day or two the blood stream is sufficiently slowed to permit clotting to take place in the sac, with permanent improvement or even cure. If recurrence takes place it has been advised to open the skull by the frontal route and apply a silver clip to the internal carotid artery above the aneurysm at the point where it emerges from the cavernous sinus to enter the circle of Willis.

In elderly persons sudden ligation of the internal carotid artery involves a considerable risk of cerebral softening This risk may be reduced by repeated digital compression of the common carotid artery in the pre-operative period or a preliminary operation may be advised to narrow the artery by tying a strip of fascia round it. Occasionally this alone may relieve the symptoms

AFFECTIONS OF THE CRANIAL NERVES

The Olfactory Nerve. The fibres of the olfactory nerve are liable to damage in fractures of the anterior fossa implicating the cribriform plate. In addition to loss of smell there is considerable impairment of the sense of taste owing to difficulty in the perception of flavours.

The Optic Nerve. The nerve fibres may be involved in the region of the optic nerve itself in the region of the chiasma or in the optic tracts. The optic nerve proper may be damaged by an injury by infection from orbital cellulitis, by aneurysm of the internal carotid artery or by a tumour

The optic chiasma is liable to pressure by a tumour of the pituitary gland or a suprasellar cyst (p 230) The optic tracts are liable to pressure by tumours in the deeper parts of the cerebral hemispheres or by tumours of the basal meninges.

Except in the case of small traumatic hæmorrhages and slight papillœdema, these affections lead to permanent blindness, partial or complete.

The Oculomotor Nerve. *This nerve supplies all the extrinsic* muscles of the eyeball except the superior oblique and the lateral rectus muscles, which are supplied by the trochlear and abducent nerves respectively

The oculomotor nerve may be paralysed by a lesion affecting its cortical centre, e.g a cerebral tumour or hæmorrhage or degeneration by a lesion affecting its intracranial course, e g a tumour gumma or aneurysm or by a lesion affecting its orbital course, e g a fracture of the anterior fossa.

Paralysis of the oculomotor nerve leads to (a) ptosis, (b) dilatation of the pupil with loss of accommodation, and (c) slight displacement of the eyeball downwards and laterally with diplopia. Often the trochlear and abducent nerves are involved also when the eyeball is completely immobile.

The Trochlear Nerve. This nerve is rarely affected alone. Almost always the oculomotor and abducent nerves are also affected (see above)

The Trigeminal Nerve. This nerve is the sensory nerve of the face, the greater part of the scalp, the mouth and the tongue Its motor root, which joins the mandibular division of the nerve after it has emerged from the foramen ovale, supplies the muscles of mastication

The trigeminal nerve is rarely injured, but it is frequently subject to neuralgia, reflex or idiopathic.

Reflex trigeminal neuralgia results from irritation by a local lesion, e.g a dental root abscess, a sinusitis or a tumour of the maxilla. The treatment is to eliminate the cause

Idiopathic trigeminal neuralgia (*Tic doloureux*) is an affection of unknown aetiology which generally occurs in persons over 50 years of age. It is characterised by intense pain of neuralgic character, often accompanied by muscular spasms or tics. At first the pain is limited to the area of distribution of one of the three divisions of the nerve especially the second or third division later it spreads to involve both the second and third divisions eventually it may overflow to the first division too Very rarely the first division is involved primarily

On examination, there is evident hyperaesthesia of the skin supplied by the affected nerve. Often there are trigger areas' at the points of emergence of the nerve fibres from their bony canals, and the slightest touch at one of these points, e.g over the infra-orbital foramen, may initiate an attack.

Treatment Any possible source of local stimulation must first be excluded. The teeth are carefully examined and submitted to radiography if necessary the nose is examined and disease of the antrum or ethmoid or frontal sinuses dealt with any ocular defect is corrected.

If these measures fail operation is indicated Formerly it was the practice to inject alcohol into the second or third division of the nerve at their points of emergence from the skull, or to divide some of the branches of those divisions individually These operations have now given place to division of the lower two thirds of the sensory root of the ganglion In expert hands this procedure is almost free from danger and its effect is to provide complete and permanent cure. The upper third of the sensory root, and the ganglion itself are preserved to minimise the degree of trophic disturbance, which might predispose to ulceration of the cornea.

The Abducent Nerve. This nerve may be injured in a fracture of the skull, compressed by a tumour or involved in a wide variety of intracranial degenerative lesions. Owing to the length of its course within the skull it is often the first nerve to be involved when the brain is displaced by a tumour When the abducent is paralysed alone a medial deviation of the eyeball results, with consequent diplopia.

The Facial Nerve. From its cortical centre the fibres descend to decussate in the pons. From its nucleus there the nerve pursues a devious course before appearing on the surface. It then enters the internal acoustic meatus and gains the facial canal, which conducts it along in relation to the tympanic cavity to the stylo-mastoid foramen

It then passes forwards dividing into its several branches, within the substance of the parotid gland

The facial nerve supplies the stapedius muscle, the stylohyoid and the posterior belly of the digastric, and the muscles of expression Through its chorda tympani it also transmits the taste fibres from the anterior two-thirds of the tongue.

Facial paralysis is readily recognised by the resulting asymmetry of the face, which is exaggerated by the unopposed action of the muscles of the normal side. In complete facial paralysis the whole side of the face is involved. The muscles are flaccid, the folds and wrinkles are smoothed out, the eye cannot be completely closed, and the mouth is drawn across towards the normal side. If the paralysis is due to a lesion of the cerebral cortex the upper part of the face remains unparalysed for it receives fibres from both cerebral hemispheres. If there is but slight paresis the only abnormality recognisable may be flattening of the naso-labial fold

The facial nerve may be injured in its course in the brain, in its bony canal, or in the neck or face.

(1) In the brain the nerve is liable to injury by a tumour or hæmorrhage or degenerative lesion in the cerebral hemisphere. The opposite side of the face is then affected and generally there is a hemiplegia too In the rare cases in which the nerve is involved below its nucleus in the pons, the facial paralysis is homolateral and is accompanied by paralysis of the abducent nerve, whose nucleus adjoins.

(2) In its bony canal the nerve may be injured by a fracture of the skull, or involved in inflammatory changes secondary to otitis media. Since the chorda tympani is liable to be damaged there may be loss of the sense of taste from the anterior two-thirds of the tongue. If the nerve to the stapedius is involved there is also an increase in the sensibility to sound. Involvement of the nerve in this part of its course is a characteristic feature of Bell s palsy (see below)

(3) In the neck and face the nerve may be compressed by a tumour of the parotid gland, or injured during the course of an operation.

Bell's Palsy This is a facial paralysis due to pressure on the nerve by inflammatory swelling of the perineural tissues within the facial canal. It is generally ascribed to a chill or to the effect of toxins from a septic focus.

The paralysis comes on quite suddenly, and is generally complete. Often it is accompanied by pain in and around the ear A few days later the affection, spreading up the nerve, may involve the chorda tympani, and cause impairment of the sense of taste. In the majority of cases the condition resolves in the course of several weeks and the paralysis gradually passes off The progress may be estimated by the electrical reactions In the minority approximately 20 per cent., the paralysis is permanent unless active treatment is instituted. The resulting disfigurement is considerable.

The treatment at first is to maintain the muscle tone by galvanism, and to relax the muscles by a padded bent wire hooked in the angle of

the mouth and around the ear If after two months there is no recovery, operative treatment should be considered The operation consists in relieving the nerve of pressure by laying open its bony canal from the stylomastoid foramen up to the level of the horizontal semicircular canal. Relief of pressure leads to rapid recovery, often starting within a day or two of operation

In cases of permanent paralysis the disfigurement may be reduced by a plastic operation designed to support the angles of the mouth and eye by a muscle swing from the temporalis or by strips of fascia lata introduced along the subcutaneous tissues from the region of the zygoma.

The Acoustic Nerve. This nerve may be involved in a fracture of the middle fossa, or compressed by an acoustic neuroma or a meningeal tumour in the cerebello-pontine angle. There is unilateral nerve deafness, often with loss of the sense of equilibrium and with rotatory giddiness.

The Glossopharyngeal Nerve. Glossopharyngeal tic is a rare affection characterised by pain in the tonsillar region and the ear It has been treated by intracranial division of the nerve.

The Vagus Nerve. The trunk of the vagus is rarely involved in injury or disease. Its recurrent branch may be injured in the course of operations on the lower part of the neck, especially during thyroidectomy or it may be compressed by an aneurysm or a tumour of the mediastinum or neck. Paralysis of the vocal cord and hoarseness of the voice result.

The Accessory Nerve. The accessory nerve is liable to injury in the neck during the course of an operation—for example, in removing tuberculous or malignant glands. The trapezius muscle is paralysed, except for that part of it supplied by the third and fourth cervical nerves. If the lesion is high in the neck the sternomastoid is also paralysed. The scapula droops and the curve of the neck is flattened but there is little functional disability

The Hypoglossal Nerve. This nerve is liable to be divided in operations on the neck or by a high cut throat wound. The affected half of the tongue is paralysed and becomes atrophied, so that when protruded the tongue is deviated towards the affected side.

CHAPTER 23

THE SPINE AND SPINAL CORD

SPINA BIFIDA

THE spinal cord arises from the ectoderm in the midline of the dorsal surface of the early embryo The ectoderm in this region is first thickened, then depressed as a groove. The groove becomes converted into a canal, which is still further depressed into the subjacent connective tissues Finally this immature spinal cord is cut off from the surface by mesoderm which grows in from either side to form the future laminæ, spinous processes and ligaments Failure in this process of development leads to various types of spina bifida. Since the separation of the cord from the surface ectoderm is completed last in the dorsolumbar region, spina bifida generally affects this part of the vertebral column.

Spinal Meningocele. This is comparable to a hernia of the spinal membranes through a gap in the vertebral arches At birth there is a swelling in the midline of the back, generally dorsolumbar The swelling is elastic and of fluid consistence and is rendered tense when the child cries or strains. The overlying skin may be normal or thin or scarred Generally there is no *paraplegia.*



FIG 133. Spina bifida (myelomeningocele) in an infant with bilateral talipes equinovarus.

The diagnosis must be made from a myelomeningocele (see below) a dermoid cyst, or a sacrococcygeal tumour Confirmation is obtained by aspirating the fluid. A lateral radiogram may be taken after injecting a small amount of air or oxygen to confirm that the sac contains no nerve tissue.

The treatment is to expose and remove the sac, close the membranes and repair the defect by suture of the lumbodorsal fascia over the opening *If* possible, operation should be delayed till the child is a year old. In some cases

the meningocele forms a safety valve to an incipient hydrocephalus and operation is then contra-indicated.

Myelomeningocele. Here a portion of the spinal cord in the dorsolumbar region lies in its primitive position close to the skin surface, and is seen as a raw, congested strip of tissue generally raised on the summit of a saccular protrusion similar to a meningocele The deformed cord may be covered by a thin layer of epidermis but this tends to become ulcerated and infection is then likely to reach the meninges and prove fatal.

A myelomeningocele is often associated with paralyses and other deformities. Surgical treatment is rarely indicated.

Syringomyelocele. This is a similar deformity with the additional feature that the central canal of the spinal cord is greatly distended.

Spina Bifida Occulta. Here the defect is minimal The cord and membranes are normally placed but there is a gap in the vertebral arches due to maldevelopment of one or two spinous processes and laminæ The overlying skin may be healthy or scarred and it may present a patch of coarse hair

The condition is often symptomless and is frequently noted in routine radiograms of the spine (Plate XI facing p 261) In other cases symptoms arise in adolescence or later owing to the presence of a *membrana reuniens* a fibrous band connecting the dura mater with the deep surface of the skin With the normal shift of the cord up the canal during adolescence this band becomes tense and drags upon the dura mater and thus exerts pressure on the anterior part of the cord, giving rise to a localised motor paresis A common result is a bilateral deformity of the feet, especially claw foot. In some cases paralytic dilation of the bladder occurs or there may be nocturnal enuresis.

In the treatment both the spinal deformity and the resulting paralytic lesion require consideration In most cases it is advisable to expose the spinal defect and free the cord from all pressure. In addition the claw foot requires treatment (p 218) and the bladder paralysis may also need treatment.

INJURIES TO THE SPINE

Fracture of the Transverse Processes

This injury is practically limited to the lumbar region. The transverse processes may be fractured as a result of a direct blow caused for example by falling against a table edge or the corner of a stair or they may be fractured by a sudden muscular contraction—for example, in an attempt to preserve the balance.

There is severe pain in the affected region with marked stiffness of the back and often some fullness of the loin, due to bruising The diagnosis is to be made from a simple sprain and from rupture of the kidney The latter condition is indicated by the presence of hæmaturia.

On radiography non union of the small ossification centre of the tip of a transverse process must not be mistaken for a fracture.

The treatment is to keep the patient in bed for two or three weeks and to apply heat. Exercises should be started after ten days. Complete recovery is to be expected in most cases in two or three months.

Injuries to the Atlas and Axis

The atlas and axis are generally injured by a fall on the head—*for* example, by diving into shallow water The atlas is fractured generally in its posterior arch, and in addition there may be a rotatory dislocation

of the atlas on the axis, or a fracture of the odontoid process of the axis. It is a remarkable fact that only about 50 per cent. of cases are fatal. The main symptom is marked stiffness of the neck, especially for nodding or rotatory movements. There may also be pain or anæsthesia in the distribution of the greater occipital nerve, due to pressure on the second cervical nerve as it passes between the atlas and axis.

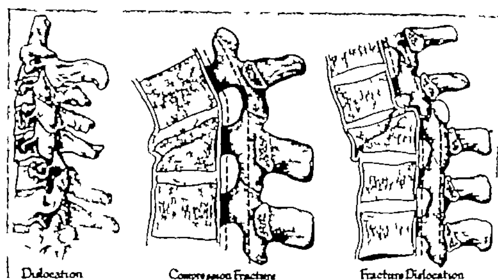


FIG. 134. Injuries to the spine. (1) Unilateral dislocation of 5th and 6th cervical vertebræ. (2) Compression fracture the spinal cord, indicated by the dotted lines, is intact. (3) Fracture-dislocation, with involvement of the cord.

The treatment is to immobilise the part completely in a plaster case, which grips the head and extends down over the thorax. Fixation must be maintained for two to three months, or longer if the odontoid process is fractured for the odontoid process rarely unites by bony union, and if the fibrous union is incomplete the process may slip out of position and press on the cord In cases with dislocation of the atlas the displacement should be reduced in the same way as a dislocation of the lower cervical vertebræ (see below) If there is difficulty in maintaining the reduction, operation has been advised in order to lash the posterior ring of the atlas to the spine of the axis which is large.

Dislocation of the Cervical Spine

A pure dislocation, unaccompanied by fracture, is rare except in the cervical part of the spine, where the articular facets are disposed more horizontally than in other regions. The majority occur between the fifth and sixth vertebræ.

The dislocation is produced by sudden forcible rotation of the head with lateral flexion of the neck, and it generally results from a fall on the side of the neck in a hunting or automobile accident.

There is an anterior displacement of the upper vertebra on the lower The ligaments of the affected joint are torn, and the upper articular

process rides forwards over the prominent edge of its fellow below The two then become interlocked In most cases the dislocation is unilateral and the cord escapes damage. In bilateral cases the displacement is so great that the cord is compressed, and a fatal result is usual, either at once or within a few days, according to the level of the injury

Clinical Features. The clinical features in an uncomplicated unilateral case may be severe, or so slight as to escape notice. Generally, there is marked stiffness of the neck, with limitation of movements,

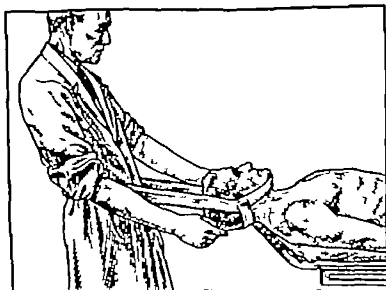


Fig 185 Method of reducing a month-old dislocation of the cervical spine.

especially rotation, and there may be a wry neck deformity The cervical nerve emerging between the two bones may be compressed, and thus there may be pain in the area of its distribution or paralysis of the muscles supplied by it.

Treatment. The most satisfactory treatment is to reduce the displacement by traction with skull callipers, and then to expose the joint and fuse it to prevent recurrence.

Compression Fracture

This common injury is caused by acute hyperflexion of the spinal column, such as may occur in a fall from a height or when a stooping miner is struck by a fall of stone from the roof. The fracture is generally situated in the dorsolumbar region. If it is in the upper thoracic region the sternum may be broken, too

Under the compression strain the cancellous bone of the vertebral body collapses and becomes wedge-shaped. The articular processes being much denser are unaffected, and consequently the integrity of the column is preserved An acute angular kyphosis results, but the cord escapes damage.

There is no paralysis, and often there is surprisingly little pain.

In a patient suffering from shock and perhaps other injuries, the fractured vertebra may escape notice.

Treatment. Formerly the treatment recommended was to manipulate the spine in hyperextension in order to disimpact the fracture, and to encase the trunk in a plaster jacket for several months. It is now recognised however that better results are obtained if the fracture is left unreduced.

In a 'stable' fracture where there is no risk of increasing the deformity the patient is kept in bed in a firm mattress for three or four weeks After the first few days he is given exercises for the spinal muscles, raising the head and shoulders and hyperextending the legs while lying prone. A good functional result is to be expected.

In an 'unstable' fracture, with severe wedging or tearing of an interspinous ligament or a dislocation, open reduction is carried out, and an internal splint of stainless steel is then applied to the spinous processes to immobilise the affected vertebræ.

Fracture-Dislocation

This injury results from more severe degrees of the same type of violence that causes compression fracture, namely an acute hyperflexion of the spine. The dorso-lumbar region is the common site.

As the upper part of the spine is driven down a shearing strain develops, and the body of the vertebra is fractured, the line of fracture being obliquely downwards and forwards. In addition, the articular processes are fractured or rarely the ligaments are torn and the articular processes are dislocated. The upper part of the spine is then displaced forwards and the cord is trapped between the laminæ above and the vertebral body below Almost always the cord is damaged beyond hope of recovery Below L.1 the cord escapes damage.

Clinical Features. The clinical features are the same as in compression fracture, with the very important additional feature of paralysis and anæsthesia below the level of the lesion. In most cases the paralysis is complete, with motor sensory and trophic loss and lack of sphincter control. Below L 1 only the cauda equina is affected.

Prognosis. The prognosis is grave in all cases. When the cervical spine is involved death occurs either at once or within a few days or weeks. In the lower part of the spine the patient can be maintained in tolerable health only by devoted nursing and medical care, preferably in a hospital with special facilities for this type of case.

Treatment. The treatment falls under two heads (1) to reduce the displacement in the hope (rarely justified) that the cord damage is not complete (2) to avert the dangerous complications of the paraplegia.

(1) In suitable cases the displacement may be reduced immediately by the method advised for compression fractures The reduction must be carried out with the utmost care. Manipulation should not be performed if radiography indicates that the articular processes are unbroken for in such cases the articular facets are interlocked and cannot

be disengaged If conditions permit, operative reduction may be advised in such cases.

(2) Two grave complications are to be feared in complete paraplegia, namely bedsores and an ascending infection of the urinary tract, the latter due to infection introduced by repeated catheterisation

To prevent the development of bedsores, the utmost care must be taken of the skin by the methods described on p 40 The patient is treated on a rotating frame and turned frequently

For the prevention of urinary infection various methods have been advised Formerly a permanent suprapubic cystostomy was advised but most surgeons now prefer to drain the bladder by a catheter The catheter must be removed and replaced every few days, for phosphatic deposits tend to form on it Intermittent catheterisation is not now generally recommended as the urine stagnating in the intervals readily becomes infected

If urinary infection does take place, the treatment is by sulphonamides or other antibiotics.

Exercises for the muscles of the abdominal wall must be carried out actively from the start. In due course the bladder can be emptied by voluntary contraction of the abdominal muscles. Catheterisation can then be dispensed with.

INJURIES TO THE SPINAL CORD

An injury to the spinal cord nearly always occurs as a complication of a dislocation or fracture-dislocation of the vertebral column Rarely it occurs without obvious bony lesion The following types of injury are recognised in order of severity —

Concussion of the Cord. This is a rare lesion (indeed its occurrence is often doubted) in which all the symptoms of a transverse lesion of the cord develop but quickly disappear leaving no residual paralysis. Probably in most cases the cord has been temporarily compressed by a displaced vertebra which has undergone spontaneous reduction. The symptoms are those of a partial paraplegia with complete motor but partial sensory loss Recovery is rapid and complete.

Partial Lesions of the Cord. The cord may sustain a partial injury in a dislocation or fracture-dislocation with little displacement, or as a result of a hæmorrhage into its substance. The two sides of the cord may be damaged unequally The sphincters may or may not be involved

The treatment depends upon the nature of the injury If a dislocation or fracture is present reduction by manipulation or operation should be carried out promptly for this is the type of case most likely to benefit from relief of the pressure on the cord

Complete Lesions of the Cord. A complete transverse lesion of the cord is generally due to a fracture-dislocation The cord is compressed and is usually crushed to a pulp beyond hope of recovery

The effects of the lesion vary according to its level.

Cervical Segments In the upper four cervical segments death

occurs immediately from respiratory paralysis. Below this level the diaphragm remains active, but respiration is laboured and death occurs in a few days or a week or two from hypostatic pneumonia. The motor and sensory loss varies according to the level. If the fifth segment is involved all four limbs are completely paralysed and anæsthetic. Below this point the deltoid and supinator muscles of the forearm are unaffected and there may be some sensation down the radial side of the limb

Thoracico-lumbar Segments In these cases there is complete paralysis, sensory motor and trophic, up to the level of the lesion At first there is the stage of ' spinal shock,' with flaccid paralysis, absence of reflexes, and atonic dilatation of bladder and rectum. After a few weeks this gives place to a state of spastic paralysis. The reflexes now become exaggerated, the Babinski extensor response appears, jerky involuntary movements of the legs occur and the bladder develops an automatic ' behaviour emptying spontaneously or when pressure is made over the pubes.

Patients with a thoracico-lumbar lesion may survive several months, or even years. They are subject to two dangerous complications, namely, bedsores and ascending urinary infection, and death is generally due to one of these causes. The treatment is described on p 251

Lower Lumbar and Sacral Segments Here the paralysis is considerably less extensive. The sensory loss varies from a small saddle-shaped patch of anæsthesia over the buttocks and perineum to anæsthesia affecting the greater part of the lower limbs. The motor loss also varies according to the precise level.

The special importance of lesions in the lower lumbar and sacral segments is their effect on the bladder The bladder has a double innervation. It receives sympathetic fibres derived from the thoracico-lumbar part of the cord and parasympathetic fibres (the nervi erigentes) from the second third and fourth sacral roots. The former are the filling " nerves, whose stimuli cause contraction of the sphincter and relaxation of the bladder wall the latter are the ' emptying nerves, which cause relaxation of the sphincter and contraction of the bladder wall. Consequently in a lesion below the sympathetic outflow i.e. below the first or second lumbar segment, the emptying mechanism is paralysed and the bladder undergoes atonic dilation The treatment is as described on p 251

TUBERCULOSIS OF THE SPINE (*Pott's Disease*)

This disease, less common than formerly is due to blood borne organisms deposited, in the cancellous bone of a vertebral body where they initiate tuberculous osteomyelitis. Later contiguous vertebræ are involved. The lower thoracic and upper lumber vertebræ are most often affected, for this part of the column is most subject to strains from weight bearing and movement.

In the common type of disease the vertebral body becomes caseous and atrophied, and collapses under the superincumbent weight, and as

the vertebral arches remain intact curvature of the spine results. Generally the kyphosis has an angular or pointed gibbus, or there may be a rounded hump comprising three or four spines.

Clinical Features. At the onset the general health is impaired, and there may be an evening pyrexia.

Weakness of the back is responsible for most of the early features To protect the spine the child no longer plays or runs about, avoids



FIG 136. Early tuberculosis of the spine in a boy aged three, who had been ailing for three months and had shown signs of weakness of the back. Note the way he *stoops* gingerly to pick a coin off the ground.



FIG 137 Tuberculosis of the spine, with psoas abscess (left). Note the *characteristic attitude*, and the flexion deformity of the left thigh, due to the abscess.



FIG. 138. Tuberculosis of the spine, in a boy aged five. After prolonged immobilisation the disease has reached a healing stage and compensatory curves are being developed.

jarring movements—for example, jumping off chairs—and keeps the spine at rest as much as possible. When standing he tries to take the weight off the diseased vertebra by supporting himself on his hands. In cervical disease he may support the head by a hand under the chin

Pain is a variable feature It occurs especially after movement of the spine and towards evening and is relieved by rest. The pain may



FIG. 139. Psoas abscess in a woman aged 38, with active tuberculosis of recent origin affecting the 1st lumbar vertebra. The abscess was treated by repeated aspiration.



FIG. 140 Psoas abscess in a woman aged 36, who suffered from tuberculosis of the 2nd lumbar vertebra. A fluid thrill could be transmitted from the abdomen to the thigh in the manner illustrated.

be felt locally in the region of the affected vertebra, or it may be referred along related nerves, and thus cause headache or girdle pains, or simulate lumbago or sciatica, according to the part of the column involved

A cold abscess may occur It is painless and gradually tracks towards the surface along the line of least resistance In the neck it usually presents in the posterior triangle In the thorax, it may come to the surface at the back, near the angle of the ribs, or track along the intercostal space deep to the breast and point near the sternum. In the lumbar region, it tracks alongside the psoas muscle, coming to the surface just medial to the iliac spine (Fig 180) or it may pass under the inguinal ligament to reach the medial side of the thigh (Fig 140)

On examination, the affected part of the spine is held rigid, and there may be a visible deformity (Fig 141)

Radiography At an early stage an area of rarefaction may be seen within the affected body Later the bone is atrophic, its outlines blurred and indistinct, and contiguous vertebræ are involved (Plate X, p 250) Collapse of the bone is noted by comparing the vertebræ in different parts of the column. Often a cold abscess may be seen The radiographic appearance is difficult to interpret in early cases especially in the lumbosacral region.

The treatment of this, as of other forms of tuberculosis, has been revolutionised as a result of the introduction of antibiotics. Formerly there was no specific treatment, any direct surgical attack on the disease was dangerous owing to the risk of secondary infection, and the main indication was prolonged immobilisation in splints or plaster casts to promote fibrosis and eventual healing Now immobilisation is still necessary but for a shorter period while operation can be performed without danger in order to remove caseous matter or evacuate pus.

The patient should be treated in a sanatorium. Streptomycin para amino-salicylic acid and iso-nicotinic acid are administered. A bed of plaster of Paris, suited to the individual patient, is prepared by applying wet plaster bandages to the prone patient, and subsequently strengthening and padding the resultant cast.

Later when the active phase of the disease is under control, operation may be required in order to remove pus and caseous matter and dead bone, and to promote rapid healing In the thoracic spine, segments of the posterior ends of two or three ribs and the adjacent transverse processes are removed (costo-transversectomy) and access is thus gained to the sides of the affected vertebral bodies. All dead tissue is removed by curette. Subsequently the aim is to allow the *kyphosis* to increase so that the diseased part is bridged by a solid mass of healthy bone. In the lumbar region, an oblique incision is used giving access to the extra peritoneal tissues. Later when ambulant treatment is started, a light steel brace is fitted to give support to the spine.

Spinal Cord Involvement (Pott s Paraplegia)

Cord involvement in spinal tuberculosis may be caused by inflammatory thickening of the membranes with associated œdema of the cord,

or by mechanical pressure, e.g from the "internal gibbus," or from a sequestrum, a cold abscess or a loosened and displaced disc.

The anterior columns of the cord are affected and a paraplegia results At first the gait is unsteady and there is a sensation of walking on wool. Later, spasticity develops in the lower limbs, with exaggerated reflexes and clonus. If untreated, contractures may develop In severe cases there are (*a*) loss of sphincteric control, with attendant risk of ascending urinary infection (*b*) trophic loss, with risk of bedsores, (*c*) sensory loss, (*d*) flaccid paralysis. These complications gravely affect the prognosis



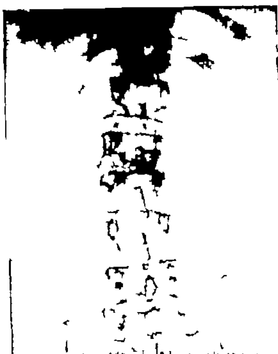
Fig 141 Tuberculosis of the cervical spine in a man aged 20 who for nearly a year had complained of stiffness of the neck and pain on movement. The deformity was of recent appearance.



Fig 142. Tuberculosis of the cervical part of the spine in a woman aged 50 who had suffered previously from tuberculosis of the lung, ribs and abdominal glands. After prolonged immobilisation with traction she has reached the ambulant stage, wearing a splint of spring steel and poroplastic felt.

The treatment in mild cases is on conservative lines, with immobilisation in a plaster shell. With cervical disease or if there are painful spasms head traction should be applied using an "ice-tong" caliper with 5 to 10 lb traction. In more severe cases, particularly if progressive, operation is indicated In acutely progressive cases it should be performed as an emergency An incision is made to one side of the gibbus the posterior ends of three or four ribs are removed along

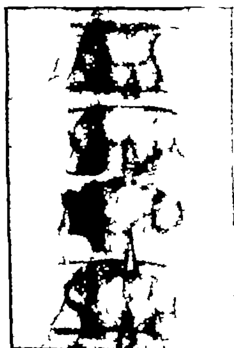
PLATE X



Tuberculosis of the 2nd and 3rd lumbar vertebræ at the stage of healing



Tuberculosis of the spine at an early stage.



Tuberculosis of spine, originating at upper surface of body of second lumbar vertebra, and causing destruction of the intervertebral disc.



Tuberculosis of spine of thirty years duration, with marked kyphosis. Note the calcified psoas abscess and the large calcified abscess in front of the sacrum.

with the corresponding transverse processes. The diseased pedicles and parts of the vertebral bodies are then erased to give access to the anterior aspect of the meninges, when the cause of pressure can be found and removed.

Sacro-iliac Tuberculosis. Rarely tuberculosis develops in the sacrum or the ilium close to the sacro-iliac joint. It is relatively painless. A cold abscess may form, and come to the surface posteriorly or in the iliac fossa. The treatment is on the same principles as for spinal tuberculosis

KYPHOSIS

Kyphosis, or hump-back, an increase in the posterior convexity of the spine, may consist in a localised deformity or a generalised curvature.

A localised kyphosis may result from (a) spinal tuberculosis, (b) a fracture or fracture-dislocation, (c) post traumatic osteoporosis. A generalised curvature, which includes the common "round shoulders," may result from postural causes (especially in overgrown, under nourished adolescents) from adolescent osteochondritis, or from spondylitis.

For the clinical features and treatment, see under the different headings.

LORDOSIS

Lordosis, an increase in the anterior convexity of the lumbar spine, is always a secondary change to compensate for some alteration in the statics of the body above or below this point. Thus it is a common feature in flexion deformities of the hip e.g in tuberculosis or congenital dislocation, or it may occur as a compensatory change in tuberculous kyphosis of the spine. It may even arise in pronounced obesity to compensate for the increased weight of the abdominal contents. The deformity often predisposes to strain of the lumbosacral joint (see p 261)

SCOLIOSIS

Scoliosis may be due to congenital defects, or to paralysis, e.g from poliomyelitis, but in most cases it is idiopathic.

The deformity is a combined lateral and rotary curvature, for lateral bending of the spine cannot occur without rotation. In rotating the vertebral bodies deviate further from the midline than do the spinous processes. In most cases the deformity consists of a primary thoracic curvature, generally convex to the right, with compensatory curves to the left above and below

The rotating thoracic vertebræ carry the chest wall so that on the convex side the ribs are displaced backwards and form a rib hump, surmounted by the scapula, which projects markedly whilst on the other side the ribs are displaced anteriorly and the breast is projected forwards. The thorax is rendered oblique and the viscera are distorted.

There may be no symptoms, or there may be weakness and tiredness of the back. Pain may be caused by contact of the rib margin with the iliac crest. On examination, the deformity is apparent. In the early stages it disappears when weight bearing is relieved by suspending the patient by the arms.



FIG. 143. Adolescent scoliosis of several years duration in a girl aged 16.

Treatment is generally of little avail. Postural habits acquired during childhood, especially those tending to impose unilateral strains, must be corrected Walking, running, cycling and swimming should be encouraged.

In later cases it is sometimes advisable to correct the deformity as far as possible by repeated manipulations followed by plaster jackets, and later to maintain the support by means of a spinal brace.

SPONDYLITIS DEFORMANS (Arthritis of the Spine)

This title includes a variety of diseases of the spinal column characterised by varying degrees of stiffness of the back and pain. In some cases the condition arises in young adults, causing much pain and progressing to complete stiffness of the back with marked disability in other cases it comes on in elderly persons, giving rise to the rounded shoulders, bent back, rheumatic pains and partial stiffness so common in old age.

Ankylosing Spondylitis is a special variety which occurs in young adults and causes great disability It gives rise to persistent

pains which at first occur mainly in the lower part of the back and are referred to the thighs and legs. Later the pains may spread upwards, causing extensive backache, girdle pains and "neuritis" of the arms or neck.

Later there is increasing stiffness of the back, which may be 'straight as a poker' or bent. The intervertebral joints undergo osseous ankylosis and eventually the greater part of the spine is fused in a solid mass. The sacro-iliac joints are involved too and often provide the earliest radiographic evidence of the disease. Ankylosis of the costo-vertebral joints also occurs and causes marked fixation of the chest.

The treatment is difficult and often unavailing X ray therapy is of value. Later when the active phase passes off a spinal brace should be fitted.

OSTEOCHONDRITIS OF THE SPINE (Scheuermann Disease)

This is an affection of the ossification centres of one or more vertebral bodies, in nature resembling Perthes disease (p 179) It may affect the primary centres of ossification at the age of about five years but more often it affects the secondary centres in adolescents between the ages of 12 and 20 It gives rise to weakness of the back, sometimes amounting to pain. A slight rounded kyphosis develops and the movements of the spine are somewhat limited. Radiographic examination shows irregularity of the surfaces of the affected vertebral bodies with slight wedge deformity The treatment is to put the spine at rest on a Whitman frame for several weeks and then to provide a plaster jacket as for fracture of the spine. The jacket should be worn for several months until radiography shows good healing to have taken place.

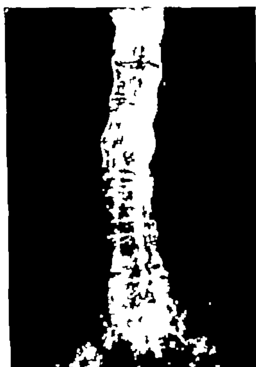


FIG 144. Ankylosing spondylitis.

LOW BACK PAIN AND SCIATICA

Pain in the lower part of the back and pain referred to the sciatic distribution may occur separately but often occur together as a result of a single cause. They can occur in either sex and can be severe and incapacitating In many women, persistent low back pain occurs as a result of disease of the pelvic viscera such as prolapse, chronic salpingitis and uterine enlargement from any cause. In men, especially men engaged in heavy labouring work, back pain (a source of much economic disablement) is sometimes due primarily to postural defects but is aggravated by arthritis, spondylitis, and strains following minor

injuries. In both sexes degenerative changes in the nucleus pulposus, leading to prolapse of the disc, are an important cause of pain both in the back and along the sciatic distribution. In later life, malignant disease involving pelvic viscera is an important cause, especially in men, cancer of the prostate, in women, cancer of the uterus, in both sexes cancer of the rectum. Secondary deposits in the bones of the pelvis, for example metastases from cancer of the breast, may cause pain of similar character.

In examining the patient, a full history should be taken. This is especially important in labourers, where the question of compensation may arise. The general habits and posture, and the position and movements of the spine and hip joints must be noted. X ray examination is essential. In older patients malignant disease in breasts and pelvic viscera must be excluded. Particular attention should be paid to evidence suggesting a prolapsed disc. If all these examinations are negative, it may be justifiable to attribute the symptoms to a strain of the spine or sacro-iliac joint, to an anatomical anomaly such as spondylolisthesis or sacralisation or finally those refuges of the destitute, "sciatica" and "fibrositis."

Prolapse of Intervertebral Disc

The nucleus pulposus, a derivative of the notochord forms the jelly like centre of the intervertebral discs. As a result of trauma or degenerative changes, it may prolapse to one side of the posterior longitudinal ligament into the spinal canal and is then apt to compress one of the

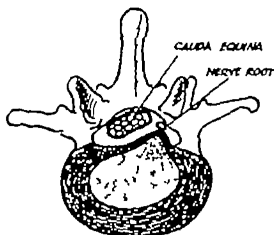


FIG 145 Prolapse of intervertebral disc.

posterior nerve roots. The commonest site is at the fourth to fifth lumbar disc. Typically following a strain or other injury to the back there is pain in the lumbo-sacral region and later in the sciatic distribution. The pain is aggravated by using the limb or stooping or by such actions as coughing, sneezing or straining which increase the intra spinal pressure. The calf muscles may be wasted and tender and the ankle jerk is impaired or lost. There may be slight sensory loss over the lateral side of the foot. X ray examination of the spine shows little abnormality. The prolapse can sometimes be demonstrated after

PLATE XI



Extensive spina bifida



Kummell's disease (post traumatic decalcification) of the 2nd lumbar vertebra.



Tumour of spinal meninges outlined by light and heavy lipiodol.

To face p. 261.

subarachnoid injection of lipiodol but this causes irritation of the meninges and is rarely advisable

The treatment in the first place is to put the patient completely at rest in bed and to give relief by aspirin or barbiturates Radiant heat and diathermy are helpful If the pain persists the prolapsed portion of disc should be removed Access is gained by removing the appropriate laminæ and exposing the disc *via* the extra-dural route The results are very satisfactory

Coccygodynia

Pain in the region of the coccyx generally follows an injury and is commonly due to fracture of the bone or to a strain of the sacro-coccygeal joint. The injury may result from a kick or a fall in the sitting position or may be sustained during parturition In other cases there is no history of injury and the cause of the pain is not obvious

The condition is almost limited to women The pain is felt when sitting or walking or during defæcation Marked tenderness may be elicited by manipulating the bone with a finger in the rectum The customary treatment is to excise the coccyx Recurrence of pain is not uncommon

Sacro-iliac Strain—The sacro-iliac joint is protected by very powerful ligaments and muscles, and it has but a limited range of movement (a slight "nodding" movement of the pelvis) yet it bears the full weight of the body at a poor mechanical advantage and consequently is liable to strain

Normally the irregularities of the opposed sacral and iliac facets fit accurately together but following an injury or unusual strain they may override and result in locking of the joint. This is especially apt to occur during or after pregnancy when the controlling ligaments are relaxed.

Pain may be situated over the joint or referred to the back of the thighs It is worse when sitting sometimes felt when lying and generally relieved on standing Pain can sometimes be elicited by flexing the hip with the knee straight (so as to exert tension on the hamstring muscles and thus put a strain upon the ischium)

The treatment is by physiotherapy and exercises.

Lumbo-sacral Strain. The lumbar spine carrying a large part of the body weight, articulates with the sacrum at an angle of 120 degrees Consequently the lumbo-sacral joint is very liable to strain.

The strain occurs especially in persons with increased lumbar lordosis for then the angulation is increased It may occur gradually for example when due to the lordosis of obesity or may follow any injury such as a fall from a height or a heavy weight falling on the bent shoulders. The movements of the lumbar spine are restricted, and there are points of tenderness over the back of the joint and the ilio-lumbar ligaments

In acute cases the patient should rest in bed for three or four weeks massage, radiant heat and diathermy may be applied. In chronic cases benefit results from exercises All postural defects must be remedied. Much improvement is obtained by reducing the weight by dieting A belt may be fitted to support the abdomen if pendulous

Spondylolisthesis. This may be regarded as a result of aggravated lumbo-sacral strain It consists in a forward and downward displacement of the body of the fifth lumbar vertebra (carrying the whole superincumbent column) in relation to the sacrum Sometimes the fifth vertebral arch is displaced too but more often the body and arch undergo separation or fracture (spondy

lolysis) and the arch remains in its normal situation when the body slips forwards.

The diagnosis is made on radiographic examination preferably by lateral radiograms which show the forward and downward displacement of the last lumbar vertebra.

Treatment is generally conservative, by muscle training and exercises. In a severe case the patient should lie in bed for several weeks with knees and hips flexed to relax the lordosis and restore the normal position of the spine.

Sacralisation of the Fifth Lumbar Vertebra. This developmental abnormality consists in fusion of variable degree, between the fifth lumbar vertebra and the sacrum

These deformities are common and generally symptomless. Symptoms are most likely to arise in unilateral cases owing to secondary strains imposed upon the vertebral articulations or on the sacro-iliac joints. The chief complaint is backache. The treatment is to support the back by a spinal brace and to institute physiotherapy by radiant heat or diathermy

TUMOURS OF THE SPINAL CORD

These tumours may be classified in three groups —

Extradural Tumours This group includes tumours of (*a*) the vertebral bodies (e.g primary osteoma or sarcoma or secondary carcinoma) (*b*) the intervertebral cartilages (e.g chondroma) and (*c*) the extradural soft tissues (e.g lipoma, or sarcoma)

Tumours of this group may give rise to pain local or referred and later to pressure on the cord. Radiographic examination is of value in the diagnosis. In the treatment a simple tumour may be removed or failing that, pressure on the cord may be relieved by laminectomy

Intramedullary Tumours This group includes glioma and gliosarcoma. These tumours arise from the neuroglia and invade the substance of the cord causing early paralysis They are not amenable to treatment.

Intradural Extramedullary Tumours This is the common type. The tumour is a meningioma or a neurofibroma, and is a small, benign encapsuled growth arising from the arachnoid mater generally close to one of the posterior nerve roots It may be removed by operation, and in early cases complete recovery may be achieved.

SACRO-COCCYGEAL TUMOURS

Tumours in the sacro-coccygeal region are generally of congenital origin They vary in nature from simple tumours such as lipoma or fibroma to highly complex development abnormalities such as teratomata or incomplete parasitic twins. Many of them are partly cystic.

The diagnosis must be made from spina bifida

The treatment is to remove the tumour As this may necessitate an extensive dissection possibly involving opening into the spinal canal, the operation should be delayed preferably for a year or more, until the infant is sufficiently robust, unless the skin covering the tumour is thin and liable to infection when operation is required more urgently

CHORDOMA

This rare tumour arises from vestiges of the notochord, the embryonic structure around which the vertebral column develops Chordoma generally arises either in the sacro-coccygeal region or at the base of the skull. It forms a slowly growing tumour lobulated and of gelatinous consistency which invades surrounding structures, and eventually may reach very large size. It is not amenable to operation and treatment by radiotherapy should be instituted.

CHAPTER 24

THE EYE, EAR, NOSE AND THROAT

INJURIES TO THE ORBIT

Contusion of the Orbit. This is the common "black-eye," and is due to a blow by a fist or other blunt object. The eyelids are swollen by extravasated blood, which appears within a short time of the injury and extends beyond the monocle distribution seen in fracture of the skull. The bruising gradually disappears in the course of two or three weeks with a characteristic play of colours due to oxidation of the blood pigment. In some cases, in addition the blood spreads into the subconjunctival tissues, where it remains bright red in colour owing to oxygenation through the delicate conjunctiva.

The condition must be diagnosed from fracture of the orbital margin or of the anterior cranial fossa.

The treatment, in a case seen immediately after the injury, is to apply firm pressure by a sponge or a pad of wool to minimise the extravasation. Once the swelling has occurred no treatment avails to hasten its disappearance.

Fracture of the Orbital Plate. This is a fracture of the anterior cranial fossa, and is generally due to a fall on the head. Often blood from the line of fracture spreads into the orbit, appearing first at the lateral margin of the conjunctiva and spreading fan wise towards the cornea. Later it may infiltrate the eyelids. If there is much bleeding into the orbital soft tissues the eyeball may be displaced forwards. If the nasal fossa is implicated there is bleeding from the nose and emphysema of the orbit may occur especially if the patient is not restrained from blowing the nose.

Penetrating Wounds of the Orbit. A wound of this type is generally due to a small scale of metal in industrial accidents or to injury by a pointed weapon or small shot. The external wound is consequently small, and may escape notice in the lax skin of the eyelid.

The injury may be limited to the connective tissues of the orbit, or it may implicate the globe or the ocular muscles or nerves. It may lead to a considerable hæmorrhage which may cause protrusion of the eyeball. More important still, it may introduce infection and lead to orbital cellulitis, especially if foreign matter is embedded.

The treatment in an early case is to excise the wound, to cleanse the deep track, and to remove any foreign matter. In a late case an orbital cellulitis may require incision and drainage.

INJURIES TO THE EYEBALL

Three types of injury to the eyeball may be distinguished.

Contusion of the Eyeball. In this injury the contents of the globe are damaged, but its outer coat (sclera and cornea) escapes *injury*. There may be a tear of the iris, dislocation of the lens, rupture of the choroid, detachment of the retina, or hæmorrhage into either the anterior or the posterior chamber. The treatment is on conservative lines with instillation of atropine. Operation is rarely indicated.

Burst Eyeball. This injury results from a blow directly on the globe. The sclera is ruptured and the lens may be extruded or the iris prolapsed. Since the rupture is from within outwards, there is little risk of infection. If the globe collapses from loss of vitreous the eye is useless and should be eviscerated. If, however, the globe is not collapsed and sight is not completely lost, it is justifiable to treat conservatively.

Penetrating Wound of the Eyeball. Here the cornea or sclera is perforated from without, the contents of the eyeball are damaged, and perhaps foreign matter is introduced. When such an injury is suspected an ophthalmic surgeon should be called in immediately. In some cases it is possible to remove the foreign body; in others, owing to the grave risk of sepsis and of sympathetic ophthalmia affecting the other eye, the eye must be removed. The eye may be enucleated or eviscerated. In *enucleation of the eye* the conjunctiva is divided close around the cornea. Tenon's capsule is opened, and the tendons of the ocular muscles are in turn hooked up and divided. The eyeball is then dislocated forwards and removed after dividing the optic nerve with a curved scissors. In *evisceration of the eye* the cornea is removed and the contents of the eye are scooped out. The interior of the sclera is then stripped of all uveal tissue by means of a gauze swab.

ORBITAL INFECTIONS

Orbital Cellulitis. This acute and dangerous infection usually follows a penetrating wound, especially if a splinter or other foreign body is carried in. The wound of entry may be tiny and invisible in the lax tissues of the eyelid.

The disease starts acutely, often with a rigor. There is severe pain in the orbital region and over the affected side of the head. The temperature is raised, and there are all the symptoms of a severe toxæmia. The eyelids are swollen, the conjunctivæ congested and œdematous. The pupil is dilated, the cornea dull and opaque. The globe is displaced forwards by œdema and fixed owing to toxic paralysis of its muscles. The contents of the eyeball may be infected secondarily.

The treatment is to give penicillin. If the disease is not arrested, it is advisable to make one or more incisions between the lid and the orbital margin. If the contents of the eyeball are infected, evisceration may be required.

Dacryocystitis. This is an infection of the lacrimal or tear sac,

which drains the tears from the conjunctivæ and transmits them to the naso-lacrimal duct. The infection may reach the sac from the con junctivæ or be secondary to a nasal catarrh. If the infection is acute, a lacrimal abscess results, forming a tender swelling deep to the medial tarsal ligament (inner canthus) Such an abscess should be opened and drained



Fig 146. Orbital cellulitis. The boy was admitted to hospital with signs of spreading lymphangitis. Under conservative treatment it has localised to an abscess in the orbit and is now ripe for incision.

ORBITAL TUMOURS

Glioma of the Retina. This tumour occurs only in children under five years of age. It is generally bilateral. The tumour causes pain in the eye, the eyeball is protruded and the pupil dilated. Blindness occurs at an early stage. On examination, when a light is shone directly into the eye, a whitish reflex is obtained instead of the normal red one

Glioma of the retina invades locally spreads to the orbital tissues and ulcerates superficially It also spreads along the optic nerve to the brain. Recurrence is usual, despite early removal.

Melanoma of the Uveal Tract. This tumour originates from the pigmented cells of the iris or choroid. It generally occurs in adults The primary tumour is often of small size, but is highly malignant, and spreads at an early stage, either by lymphatics to the regional glands or by the blood stream to distant viscera. Recurrence is common after operation but may be delayed for several years

Tumours of the Orbit. The bones of the orbit may be the site of ivory osteoma, sarcoma and other bone tumours. In young children the region is a well-known site for secondary metastases from a neuro-blastoma of the adrenal gland

AFFECTIONS OF THE EXTERNAL EAR

Deformities. Absence of one auricle and external meatus is a rare deformity for which no treatment is available.

Accessory auricles are not uncommon. They consist of small portions of cartilage, and may be situated close to the tragus, on the lobule, or in the neck. They may be removed without difficulty

Abnormal prominence of the auricles is an unsightly deformity often familial. It is treated by excising an ellipse of skin from the posterior aspect of the pinna close to its root, and suturing the wound thus produced

Injuries A blow on the ear may lead to effusion of blood into the tissues of the auricle—hæmatoma auris. Since the skin is firmly attached to the perichondrium, quite a small effusion causes great pain. The effusion may impair the blood supply to the cartilage, which may necrose, or infection of the cartilage may be a complication. Often a permanently thick ear remains.

The treatment in an early case is to apply compression by means of a pad of wool. If the swelling has already occurred and the pain is severe, the treatment is to incise and turn out the clot.

Wax in the Ear The secretion of wax varies greatly It tends to be increased in the presence of dermatitis and other irritating conditions of the meatus. Impaction of a lump of wax in the deeper part of the meatus causes deafness, often of sudden onset and usually painless. Wax is the commonest cause of deafness at any age.

The treatment is to remove the wax by syringing with warm water or saline solution. If necessary the wax is first softened by instillations of hydrogen peroxide. When the ear is being syringed a kidney dish is held under the auricle close to the cheek. The ear syringe is filled with water or saline at body temperature, with care that no air bubbles remain. The auricle is then drawn upwards and backwards to straighten the canal, and the syringe nozzle is inserted into the meatus. The stream of lotion is introduced slowly at first, then forcibly, and is directed along the roof of the canal in order to dislodge the wax.

Foreign Bodies in the Ear Foreign bodies, such as buttons, beads and peas, may be impacted in the external meatus, especially in children. They are generally situated in the deeper part of the canal. Owing to *œdema caused by pressure, or by unskilled attempts at removal*, the body may become tightly impacted

The treatment in the first place is to attempt its removal by syringing If this fails, the ear should be packed gently with gauze soaked in 10 per cent cocaine with a few drops of adrenalin, and syringing repeated If this fails, the body should be removed by means of a blunt hook or an aural forceps. In children a general anæsthetic is preferable to minimise the risk of damaging the drum. Rarely if these measures fail it is necessary to turn the ear forward by an incision like that for the mastoid operation and to open the canal from behind.

Dermatitis of the Meatus. This condition may be caused by the irritation of purulent discharge from middle-ear disease, or may occur quite apart from ear disease in association with dermatitis of the scalp or auricle. It causes pruritus and a watery discharge. The treatment is to keep the ear clean by syringing and to apply a simple ointment containing 10 grains each of salicylic acid and precipitated sulphur in 1 oz. of petroleum jelly If middle-ear disease is present it must be treated

Furuncle of the Meatus. This is a staphylococcal infection gaining access at a hair follicle or skin gland It may be associated with boils elsewhere, or occur as a complication of dermatitis of the meatus. Owing to the firm attachment of the skin of the meatus, even a small inflammatory swelling is very painful Deafness may arise if the meatus is blocked, and there may be swelling and pain on pressure behind the ear These signs may lead one to suspect middle-ear disease and mastoiditis, but the diagnosis may be made on examination of the meatus, and on the observation that pain is caused by touching the meatus with a probe, or even by moving the auricle.

The treatment, in an early stage, is to instil a solution of 5 per cent. phenol in glycerine or to pack with a pledget of gauze soaked in ichthyol glycerine and to apply hot fomentations. If suppuration occurs, the furuncle should be incised preferably under general anaesthesia. Later the tendency to boils or dermatitis should be corrected by appropriate treatment.

AFFECTIONS OF THE MIDDLE EAR

Inflammation of the middle ear may be catarrhal or suppurative. It may be confined to the tympanum (otitis media) or involve the antrum and mastoid air cells (mastoiditis)

The affection is nearly always derived from the naso-pharynx by way of the Eustachian tube. It is common in children as a result of naso-pharyngeal catarrh. The presence of adenoids predisposes to middle-ear disease.

The infecting organisms include the catarrhal micrococci and streptococci.

Otitis Media. In this condition a catarrh spreads up the Eustachian tube to the tympanum. The Eustachian tube is closed by œdema, and



FIG 147 Tympanic membrane (left), showing the site for paracentesis, in the lower posterior part of the drum.

a vacuum may form in the tympanum, or a serous exudate may occur (catarrhal otitis) If the infection is more severe a purulent exudate rapidly develops (suppurative otitis) If unrelieved the pus may burst

through the tympanic membrane, or may spread to the mastoid antrum and air cells.

The onset of the disease is usually acute. There are discomfort and a feeling of fullness in the affected ear and these gradually increase until the pain is severe. There is partial deafness on the affected side.

On examination, the ear-drum is found congested and lacks its normal blue-grey lustre It may be abnormally concave owing to the vacuum within Later *the ear drum is intensely inflamed and bulges* outwards into the meatus, and the anatomical landmarks on its surface are obscured A yellow spot may appear, indicating an imminent perforation

Treatment. Antibiotics should be given at once. In most cases penicillin is effective, and may well be given along with a sulphonamide. When the organism proves to be penicillin resistant a change should be made, preferably to chloromycetin

If the condition does not improve rapidly under this treatment para centesis should be performed In particular paracentesis is indicated (1) if the pain is not relieved within twenty four hours (2) if the deaf ness is severe (3) if there is any vomiting, nystagmus or vertigo or (4) if on examination the drum is seen to be bulging towards the meatus.

Paracentesis is carried out under general anæsthesia. The meatus is cleansed and painted with iodine, and a large speculum is introduced The drum is then incised by a paracentesis knife or myringotome. The incision is made obliquely in the lower posterior part of the drum to avoid the ossicles.

Acute Mastoiditis. This complication is much less common than formerly The infection spreads posteriorly through the aditus to the antrum and thence to the air cells, which fill with pus. If not relieved the infection may spread from the mastoid (1) superficially forming a sub-periosteal abscess (2) inferiorly forming an abscess below the mastoid process (Bezold s mastoiditis) or (3) deeply forming an extradural abscess in the middle or posterior cranial fossa. These are now rare *complications.*

The treatment in the first instance is by antibiotics, which usually prove effective. If they fail, it is necessary to perform the simple mastoid operation in which the mastoid air cells are exposed and the pus evacuated.

A curved incision is made ½ inch behind and parallel to the posterior attachment of the auricle, extending down to the tip of the mastoid process The mastoid cortex is then exposed and removed with a gouge and hammer thin shavings of bone being elevated in a downwards and forwards direction The wound is then deepened until the antrum is exposed. The *antrum is identified* by passing a probe through the aditus into the tympanum The mastoid air cells are then cleared out. Finally the wound may be packed and allowed to granulate, or in favourable cases may be sutured with drainage.

AFFECTIONS OF THE NOSE AND NASO-PHARYNX

Injuries to the Nose. As a result of a direct blow there may occur a fracture or dislocation of the nasal bones or a dislocation of the cartilage. Any of these injuries may be accompanied by fracture of the nasal septum.

The injury gives rise to pain and severe epistaxis. The nose may be flattened or displaced laterally, and often the full extent of the deformity is obscured by the swelling which is generally present.

The treatment is to reduce the displacement by manipulation under general anæsthesia. This is assisted by inserting the blades of a dressing forceps, protected by rubber tubing into the nostrils. Once the deformity is corrected it does not tend to recur and no splintage is necessary, though a malleable metal protector may be worn over the nose for a few days.

Another result of injury is a *hæmatoma of the septum*, which presents a smooth rounded swelling just within each nostril. The hæmatoma is painful, and may obstruct nasal respiration. If infected it gives rise to a septal abscess. The treatment is to incise the swelling under local anæsthesia, to evacuate the contents and to drain with a gauze wick.

Rhinophyma Potato Nose. This condition is due to a diffuse adenomatous proliferation of the sebaceous glands of the nose. There is a nodular reddish or purple swelling of the tip of the nose, which may attain the size of a walnut. The condition is popularly but unjustifiably associated with chronic alcoholism. The treatment is to pare off the redundant tissue, taking care not to open into the nostrils. Hæmorrhage can usually be arrested by pressure. The raw area quickly heals over with epidermis.

Deviation of the Septum. This deformity may be developmental in origin, or arise as a result of an injury The septum may be " C " shaped or " S " shaped and may thus intrude upon one or both nostrils. Often the deviated septum presents ridges or crests, one of which may come into contact with the inferior turbinate.

A deviation of the septum may cause no symptoms, or may give rise to obstruction of one or both nostrils. In the latter case it predisposes to recurring nasal catarrh and to paranasal sinusitis.

If treatment is required the deformity may be corrected under local anæsthesia by the operation of submucous resection, by which the septal cartilage is removed through a small incision near the front of the septum, after the mucous membrane covering its two sides has been elevated. After operation the nostrils are packed and the patient is kept in bed for three or four days.

Nasal Polypus. This is a sessile or pedunculated mass of thickened submucous tissue covered by mucous membrane. It may be regarded as a form of hyperplastic granulation tissue, and is generally a result of the continued irritation caused by chronic rhinitis or an infection of the paranasal sinuses.

It commonly gives rise to partial or complete obstruction of the

affected nostril, and leads to recurrent headaches. By its presence it leads *to persistence of the rhinitis or of paranasal sinusitis.*

The diagnosis is to be made from (1) enlargement of the inferior turbinate, by its mobility and by the fact that a probe may be passed round it (2) *malignant disease, especially sarcoma,* which may resemble a simple polypus very closely, and can sometimes be distinguished with certainty only by microscopic examination.

The treatment is *to remove the polypus with a snare. Microscopic* examination should be performed as a routine. The causative lesion also requires its proper treatment.

Epistaxis. Bleeding from the nose *may occur in the following* conditions (1) injuries to the nose (2) diseases of the heart and kidneys, especially if the blood pressure is raised, (3) hæmorrhagic dyscrasias, such as scurvy purpura, hæmophilia (4) acute fevers, such as typhoid, measles, influenza, scarlet fever- (5) tumours of the nose or naso-pharynx.

Much more commonly, however epistaxis occurs without obvious cause in healthy persons. In such cases the bleeding generally originates in "Little's area," near the lower anterior angle of the septum. At this point a small ulcer is often found. The bleeding is often caused by careless attempts to remove a scab from this area.

The treatment is described on p 89

Foreign Bodies in the Nose. Foreign bodies in the nose, such as buttons, beads or peas, are common in children. If treatment is adopted at once they can be found and removed by means of a hook or forceps without difficulty If, however the foreign body is allowed to remain in the nose it becomes obscured by œdematous swelling of the mucous membrane, and is difficult to locate or dislodge. A retained foreign body may give rise to a purulent and often fœtid discharge. It must be remembered that in young children a unilateral discharge from the nose may be the only evidence of a foreign body for often there is no *history obtainable.*

The treatment in late cases is to apply 10 per cent. cocaine with adrenalin in order to diminish the œdema. Once the body has been located it can generally be removed without difficulty or displaced back into the naso-pharynx. *In children a general anæsthetic is usually* advisable.

AFFECTIONS OF THE PARANASAL SINUSES

The maxillary antrum, the frontal, ethmoid and rarely the sphenoid sinuses are liable to infection secondary to naso-pharyngeal catarrh. The infection may occur in a healthy patient as a result of an ordinary cold, but it is most common in persons with some such predisposing factor as a deviated nasal septum. At first the infection is a simple catarrh. If, as often happens, the outlet from the affected sinus becomes blocked, its air is absorbed and a "vacuum sinus" develops This often proceeds to suppuration within the closed cavity unless free drainage be effected Subsequently chronic suppuration may persist.

Frontal Sinus Acute frontal sinusitis starts as a catarrh, and may progress to a "vacuum sinus" or to suppuration.

There is severe headache, with pain most marked over the sinus and radiating up the forehead. There may be œdema and congestion of the skin over the sinus.

The treatment in the first place is conservative. To establish internal drainage a pledget of wool soaked in adrenalin is applied to the middle meatus, repeatedly if necessary, and menthol sprays and inhalations are repeated every few hours. Penicillin should be administered.

If these measures fail, the anterior end of the middle turbinate bone should be removed to give access to the fronto-nasal duct, which is dilated with a special bougie. If the suppuration still continues it may be necessary to establish open drainage through an incision below the medial part of the eyebrow

Maxillary Antrum. Maxillary antritis may result from infection from the nose, or from a dental abscess, especially of the upper canine tooth. Acute maxillary antritis gives rise to pain over the maxilla and to infra-orbital neuralgia, often severe. The temperature may be raised and there is some malaise. The tissues of the cheek may be œdematous, and there is tenderness on pressure, especially over the infra-orbital foramen.

Transillumination, with an electric bulb in the mouth, may show some impairment of the normal clarity of the sinus. The diagnosis is confirmed by radiography which shows opacity on the affected side. If necessary further confirmation is obtained by proof puncture, which consists in passing a special curved trocar and cannula into the antrum through the lateral wall of the inferior nasal meatus. This can be done under local anæsthesia.

The treatment in the first place is conservative, on the lines recommended for frontal sinusitis. If these measures fail the antrum should be washed out through a cannula inserted as for proof puncture. Lavage may be repeated if necessary If the suppuration continues, operation is required, for the normal maxillary ostium, which opens near the roof of the antral cavity does not provide dependent drainage. The customary operation is to make a new opening into the antrum from the inferior meatus. Rarely it is advisable to open the antrum from the canine fossa.

Ethmoid Sinuses. These sinuses include the posterior ethmoids, opening above the middle concha, and the anterior ethmoids opening below it. The ethmoids are often involved along with other paranasal sinuses The infection gives rise to headache, pain between the eyes, and a purulent nasal or post-nasal discharge. It predisposes to chronic nasal catarrh and to nasal polypi it may lead to orbital cellulitis or to intracranial suppuration The treatment is similar to that described for frontal sinusitis. If operation is required the ethmoids are opened and drained from within the nose.

AFFECTIONS OF THE TONSILS

Acute Follicular Tonsillitis. This is an acute infection of the tonsils by streptococci, and occasionally by other organisms present in the throat. It is characterised by swelling and congestion of the tonsils and by the presence of yellowish spots due to pus and epithelial *débris* within the follicles or crypts of the mucous membrane.

The treatment is to apply fomentations or a thick pad of wool to the neck, and to administer antibiotics.

Acute Suppurative Tonsillitis (Quinsy) This is a severe form of tonsillitis due to invasion by pyogenic organisms, especially streptococci. It is characterised by suppuration either within the tonsil, or more often, in the peritonsillar region.

The temperature is raised and there is much pain, especially on swallowing The glands in the neck are enlarged and tender

On examination there is marked swelling in the tonsillar region, extending to the peritonsillar tissues, the soft palate and the anterior pillar of the fauces. The uvula is markedly swollen and œdematous, and is displaced away from the affected side.

The treatment in the early stages is the same as for follicular tonsillitis. If suppuration occurs, the abscess should be opened over the most prominent part of the swelling, which is generally just above the upper pole of the tonsil. The abscess may be opened with a sharp-pointed pair of sinus forceps or a knife guarded by adhesive plaster to within ½ inch of its tip It is preferable to paint the affected area with 10 per cent. cocaine solution as a preliminary step

Tumours of the Tonsil. *Lymphosarcoma* may arise in the tonsil at any age, especially in adolescence and early adult life. It forms a soft vascular or œdematous growth which projects into the pharynx and invades adjacent tissues. The regional glands in the neck are involved at an early stage.

The symptoms are variable. In some cases pain on swallowing or difficulty in respiration draws attention to the disease. In others the first sign is a swelling in the neck due to glandular enlargement. On examination, the presence of the growth is evident. It is to be diagnosed from simple hypertrophy of the tonsil by its greater size, vascularity and fixation. The treatment is by radiotherapy

Carcinoma (squamous epithelioma) forms an ulcerating growth with a raised rolled edge and an indurated base, somewhat similar in gross character to a carcinoma of the tongue. The glands of the upper deep cervical group are involved early In the early stages there are few symptoms. Later pain on swallowing develops, the tongue is fixed to the growth and there is difficulty in phonation the movements of the jaw are impaired, and the mouth can with difficulty be opened. The breath is fœtid, and purulent saliva dribbles from the mouth.

The treatment is by radiotherapy

CHAPTER 25

THE FACE, MOUTH, TONGUE, JAWS

FACIO-MAXILLARY INJURIES

INJURIES to the face and jaws occur commonly as a result of road accidents and—in particularly severe form—in warfare. To prevent facial disfigurement (with its consequences of mental distress and even psychological disturbances) such wounds must be repaired with great care, and often a plastic surgeon should be consulted. In jaw injuries a specialist dental surgeon should also be called in.

Injuries to the Face. Owing to the vascularity of the part, wounds of the face are resistant to sepsis and heal very rapidly. Primary union may be expected in the great majority of cases even when the initial treatment has been delayed as long as twenty four hours.

In clean-cut wounds no excision is required, and after thorough cleansing with soap and water the wound may be sutured without drainage, while even a lacerated wound requires only minimal excision of the devitalised margin.

Sutures should be of horse-hair or fine silkworm gut, preferably attached to eyeless needles. They must be applied so as to bring the skin edges into accurate apposition, especially at the red margin of the lip or in wounds of the eyelids or eyebrows. The stitches should be inserted close to the wound margin and without tension, to avoid disfiguring transverse scars. They should be removed in forty-eight hours. If the skin cannot be closed without tension the raw surface must be covered by a graft.

Fracture of the Maxilla. *Fracture of the zygomatic process* is a common injury in which as a result of a direct blow the zygomatic arch is driven medially and backwards. The fragment is impacted into the body of the maxilla and may cause pain through compression of branches of the maxillary nerve. The treatment is to introduce a rigid instrument such as a narrow periosteal elevator through a small incision behind the hair line, and to lever the arch up into position.

Fracture of the alveolar margin is less common. The fragment is forced upwards and backwards and generally is impacted. It should be dislodged by digital pressure and replaced accurately to secure exact dental occlusion, and immobilised by a dental splint as described below.

Crush fracture of the maxilla—the "middle-third-of face" fracture—is a severe injury in which, as the result of a direct smash, the whole hard palate along with the alveolus is forced backwards, giving rise to a "dish face" deformity. The fragment may be impacted or float freely supported only by its facial attachments. The nasal bones may be fractured too. Disimpaction is carried out by forcible rocking and

rotating movements. In some cases the fragment can be immobilised by a dental splint locking with the lower teeth, in others a special splint like a denture is attached to a strut which is carried up in front of the face to a plaster-of Paris head cap

Fracture of the Mandible results from a direct blow caused for example, by a kick from a horse or by falling on the jaw The bone generally breaks at its weakest point, obliquely upwards and backwards, through the inferior alveolar foramen and the large socket of the canine tooth. Not infrequently the fracture is bilateral. Rarely the mandible breaks at the symphysis, or in the neck of the bone just below the condyle.

There is often considerable displacement of the fragments, and consequently the mucous membrane is usually torn. Infection may gain access in this way and lead to osteomyelitis of the mandible. The displacement also leads to mal alignment of the teeth, and often the tooth nearest to the line of fracture is loosened

The treatment in an emergency is to support the jaw by a bandage. As soon as possible the services of a specialist dental surgeon should be sought. Any teeth loosened by the fracture should be removed, for their presence will hinder union though they may be retained tempor arily to control an otherwise edentulous fragment. Exact reduction must then be secured, and maintained by dental splintage.

In comminuted compound fractures, small fragments that are completely devoid of attachments should be removed, but all others may be preserved In fractures with much bone loss, as occurs commonly in gunshot wounds, the early treatment must be so designed as to *maintain the fragments in their correct relationship to the upper jaw* with exact dental occlusion and in particular to prevent the anterior part of the mandible from being drawn backwards. This is done by inter maxillary splinting (see below) When the wound is healed, if as commonly happens, there is non union of the fragments a bone graft is embedded across the gap The graft is generally obtained from the iliac crest, which is particularly suitable as regards shape and density

Methods of Dental Splintage If teeth are present in both fragments immobilisation is obtained either by inter-dental wiring or preferably by cap splints of cast metal which fit accurately over the crowns of the teeth. Sometimes it suffices thus to splint the teeth of the fractured bone alone—maxilla or mandible—and the normal range of mandibular movement may then be possible. More often, when the mandible is fractured, it is necessary to fix the wiring or the cap splint to the upper teeth also (inter maxillary splintage) In such cases the patient is fed by means of a tube and one or more teeth may require to be removed to allow of its passage into the mouth. In edentulous patients, Gunning splints are used, which resemble the vulcanite plates of ordinary dentures. The upper and lower plates are fixed to each other by adjustable screws, leaving a space for feeding If much of the mandible has been lost, e.g in war wounds, it is necessary to insert

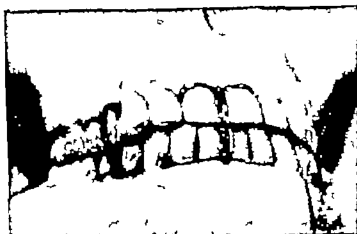


Fig. 148. Model showing interdental wiring for fracture of the mandible.

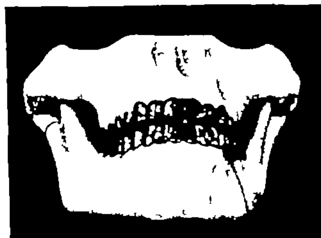


Fig. 149 Cap splints for fracture of mandible. The fusible metal splints are cast to impressions of the teeth, which they fit tightly The splints are held together by a detachable screw-bar



Fig. 150. Gunning splints for fracture of mandible in edentulous patient. The wires encircling the mandible are not usually required.

stainless steel pins through the skin into the fragments that remain, connecting the pins externally by a crosspiece.

In all cases where splintage is used the toilet of the mouth requires particular care Mouth washes are used frequently and in compound fractures the wound should be irrigated

TUMOURS OF THE FACE

The skin of the face is a common site for tumours. In addition to simple angioma, sebaceous cysts and sebaceous adenoma, there are two common invasive tumours, rodent ulcer and squamous epithelioma.

Rodent Ulcer The basal cell carcinoma is a common tumour It occurs in elderly persons and usually arises in relation to the medial



FIG. 151 Rodent ulcer at medial canthus.

canthus of the eye, the lateral aspect of the nose or the neighbouring portion of the cheek It starts as a small nodule covered with thin, tense epidermis, but sooner or later the epidermis gives way and an ulcer forms. The ulcer has a smooth or granular surface, at first often covered with a dry scab The edge of the ulcer may be smooth and cleanly cut, but usually it is slightly rolled or beaded The edge is not raised or thickened to the same extent as a squamous epithelioma, nor is there so much induration round the edge and at the base.

The ulcer extends very slowly over a period of years sometimes healing in part, then enlarging again and deepening, perhaps ultimately to involve the nasal cavity or the eyeball. It does not metastasise.

The diagnosis is to be made from squamous epithelioma, and, in early cases, from sebaceous adenoma or even a cyst. As a routine, biopsy is performed.

The treatment, in most cases, is by exposure to radium. If given in adequate dosage, this treatment is curative. If the tumour is on the eyelid radium cannot be used, owing to the risk of damage to the

eye, so the best treatment is to excise the tumour along with a margin of healthy skin. The same treatment is advisable for a rodent ulcer involving the nasal cartilage, and in other conditions where radium is contra-indicated.

Squamous Epithelioma. This tumour may arise in any part of the face, and is especially common on the lower lip (p. 270). It occurs most



Fig. 152. Epithelioma of face in man aged 81.



Fig. 153. Early carcinoma of face in area of chronic lupus with extensive scarring. Note the well formed nose, built up by pedicle graft with cartilage implants.

commonly at the site of an old scar, burn or patch of lupus. It is frequently seen in seamen and others exposed to strong actinic rays. Like rodent ulcer, it is exceedingly common in countries such as Australia, where bright sunlight and a clear atmosphere permit excessive exposure to ultra-violet rays.

The tumour ulcerates at an early stage, forming a typical epitheliomatous ulcer with a small irregular raw area, a raised indurated margin, and a stony hard base. It invades surrounding tissues and spreads to the regional glands in the upper part of the neck.

The treatment in most cases is by exposure to radium, usually applied as needles inserted close around the tumour Sometimes in a small early tumour it is more satisfactory to remove it by operation, along with an ellipse of healthy skin. This method of treatment is also appropriate where radium is contra indicated, for example in a tumour involving the eyelid or the nasal cartilage or the aural cartilage.

Lupus carcinoma is a squamous epithelioma arising in an area of skin involved in tuberculous lupus. The growth is especially apt to originate after X ray treatment of the lupus. It ulcerates early, and gradually enlarges, but owing to occlusion of the lymphatics of the tuberculous skin it does not metastasise until late.

Molluscum sebaceum resembles carcinoma microscopically but differs in its behaviour It grows rapidly (within a few weeks) forming a projecting growth surmounted by horny matter and after a few months undergoes spontaneous regression. The cure can be hastened by radiotherapy

AFFECTIONS OF THE LIPS

Fissures of the Lips. Painful fissures of the lips occur mainly in cold, dry weather They are situated most often in the midline of the lower lip or at the angle of the mouth. The treatment is to apply a simple ointment and to protect the lip at night with a strip of adhesive plaster If these measures fail and the fissure becomes indurated, a small wedge of the lip, including the fissure, should be excised.

Carbuncle of the Lips. This is an acute staphylococcal infection originating in a hair follicle or in a blister or herpes of the lip It spreads extensively causes much œdema of the lip cheek and orbit, and leads to severe toxæmia. It may spread either by the angular and ophthalmic veins or by the pterygoid venous plexus, to the cavernous sinus, and give rise to cavernous sinus phlebitis.



FIG. 164. Carbuncle of the lip of three days duration, originating as a small septic spot. The œdema of the face and eyelids is evident. Cavernous sinus thrombosis supervened in this case, as a result of spread *via* the pterygoid venous plexus.

The treatment is similar to that of carbuncle in other sites (p 40) The infection usually responds promptly to penicillin

Simple Tumours of the Lips. Simple tumours of the lips include hæmangioma, lymphangioma and papilloma

A hæmangioma is a congenital tumour which forms a soft spongy mass of vascular tissue in the substance of the lip The mucous membrane over it may be normal or covered with telangiectases. The treatment is by excision or electrolysis.

A lymphangioma is very similar in appearance. The lip is thickened and protruded with its mucous membrane everted by a firm mass in the submucous tissue. The treatment is by excision.

A papilloma is a simple warty growth. It is to be distinguished from an early epithelioma. It should be removed.

Epithelioma of the Lips. Epithelioma is the commonest and most important tumour of the lip It occurs most often in men, especially



FIG 153 Squamous epithelioma of the lip, in a clay pipe smoker

in those who smoke short, hot pipes, e.g clay pipes. Sometimes the tumour arises at the site of a previous lesion, such as a scar or an old burn. In the great majority of cases it is situated on the lower lip and characteristically it originates to one side of the midline, at the point most liable to irritation from the pipe.

In the early stages the tumour takes the form of a warty growth or a fissure. Later an ulcer forms, which scabs over and then recurs. The ulcer assumes a typical malignant character with a small raw area, a raised, indurated edge and a hard base. The tumour spreads both superficially and under the mucous membrane to form a hard button of induration extending beyond the ulcerated area. Later it involves the submental and submaxillary glands, but rarely metastasises to more distant sites. Death results from local sepsis, with abscess formation in the regional glands, or from septic bronchopneumonia.

The diagnosis in the early stages is to be made from a simple ulcer or fissure. Later there is rarely any difficulty in the diagnosis. If in

doubt, a small portion of the edge of the ulcer should be taken for microscopic examination.

The treatment is preferably by exposure to radium which is generally applied in the form of needles introduced into the tissues of the lip around the growth If radium is not available the growth must be excised, along with an adequate amount of healthy tissue around it, and the resulting defect repaired by a plastic procedure

If there are palpable glands they should be removed. The operation usually takes the form of a block resection of the contents of the submental triangle and the digastric and carotid triangles of the affected side.

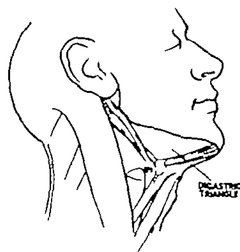


FIG. 156. Digastric triangle, the common site of early lymph node metastases in carcinoma of lip or tongue.

If no glands are palpable, the consensus of opinion at the present time is against operation for if adequate treatment (by radium or excision) is applied to the primary growth, the risk of subsequent glandular involvement is small. It is, of course, essential to examine the patient at regular intervals to guard against this possibility

HARE-LIP AND CLEFT PALATE

The upper lip nose and palate are developed from three embryonic processes one in the midline and one at either side.

The *frontonasal process* originating from the prosencephalon, grows downwards in the midline, and ultimately gives rise to the nostrils, the nasal septum, the philtrum or median segment of the upper lip, and the premaxilla, which includes the incisor portion of the alveolar margin and the small portion of the hard palate immediately behind.

The *maxillary processes* growing in from the sides, give rise to the cheeks, the lateral parts of the upper lip and the whole of the hard palate, except the premaxilla.

Hare-lip and cleft palate result from defective fusion between the frontonasal and maxillary processes. They may occur separately or together

Hare-lip The cleft of a hare-lip is almost always situated to one side of the midline at the line of separation between the philtrum (derived from the frontonasal process) and the lateral part of the lip (derived from the maxillary process)

A hare-lip may be unilateral or bilateral and it varies in degree from a small notch of the red margin of the lip to a cleft opening into the nostril. In the more extensive cases there is a cleft of the alveolar



Fig 157 Bilateral hare-lip and cleft palate.

margin with one of the incisor teeth missing and the defect may extend back and communicate with a cleft palate. The terms *pre-alveolar alveolar post-alveolar* and *complete cleft* are sometimes applied to indicate the extent of the defect.

In unilateral cases the affected side of the nostril is flattened and deformed in bilateral cases the median segment of tissue, including the premaxilla and the overlying soft tissues or prolabium, forms a prominent ugly mass which projects forward in front of the rest of the mouth.

The treatment of a hare lip should be carried out as soon as the child is fit for operation, for the defect interferes with sucking and predisposes to malnutrition. Some surgeons operate shortly after birth, others prefer to wait for a month or two At the first operation the edges of the cleft are rawed and sutured, after mobilising the lip from the underlying bone to which it is bound down. A second cosmetic operation is required in later childhood to excise the scar which is often stretched, and to remedy the unsightly backward displacement of the lip

Cleft Palate. The cleft may involve the uvula alone or the soft palate, or it may extend forwards through the hard palate. It may extend through the alveolar margin and communicate with a hare-lip In some cases the cleft bifurcates anteriorly and communicates with a double hare-lip—a complete failure of fusion between the embryonic processes.

The presence of the cleft permits regurgitation of food from the mouth into the nose, interferes with feeding and predisposes to mal nutrition. It also leads to great difficulty in phonation, and is responsible for a characteristic speech defect.

The treatment is by operation, which is preferably delayed until the age of one or two years. At the operation the aim is to provide a soft palate sufficiently mobile to meet the posterior pharyngeal wall and thus to permit closure of the sphincter between the naso-pharynx and the oral pharynx. The anterior part of the cleft, which lies in the hard palate, is of less importance, and if it cannot be repaired by operation it may be occluded by an obturator After operation careful training in voice production is of especial importance.

Wounds of the Tongue. The tongue may be wounded by external violence, or by being bitten especially in epileptics. The hæmorrhage may be severe, especially in a deep wound at the back of the tongue. In an emergency the bleeding can be arrested by hooking a finger round the back of the tongue and forcing it forwards against the mandible. A small wound should be closed by a few interrupted catgut sutures passed through the mucous membrane. Rarely if there is profuse bleeding from a deep-seated artery the vessel must be ligated or under run with a catgut stitch. In such cases general anæsthesia is required.

A wound of the tongue is apt to become infected. Mouth washes should be advised to counteract this.

GLOSSITIS AND ULCERS OF TONGUE

Since Hippocrates day it has been well known that the tongue mirrors many systemic diseases and may present special features of diagnostic significance. In this category come the coated tongue of many acute infective processes, the atrophy of pernicious anæmia and vitamin deficiencies, and the many varied manifestations of syphilis.

As an independent disorder true glossitis is rare. More commonly inflammation of the tongue is secondary to septic processes in the teeth and gums, or to the following types of ulcer

Simple Ulcers Ulcers of this type occur on the tongue, the floor of the mouth, or the inner surface of the cheek. They are extremely painful. As a rule, a single ulcer develops, remains for a week or ten days and then heals spontaneously only to be followed by others of similar character in different parts of the mouth. They are most common at pressure points in relation to a denture or a jagged tooth. The individual ulcer is small and rounded with a shallow crater covered with a thin grey pellicle, and a surrounding zone of intense hyperæmia. The regional glands, particularly those in the submandibular triangle, are enlarged and tender There may be a certain amount of mild toxæmia. Similar ulcers larger and multiple, occur in the course of severe acute diseases such as septicæmia.

The cause of these ulcers has not been established. They have been attributed at various times, to a virus, to allergy from some component of dentures, to dental sepsis, and to vitamin deficiencies. Certain

individuals are specially susceptible, and occasionally two members of a family are susceptible.

The various methods of simple oral hygiene generally recommended do little beyond reducing the secondary infection In some cases a very small dose of an antibiotic such as aureomycin applied locally to the ulcer in the form of a spray or powder, is remarkably effective. Only a small amount is used and for twelve hours at the most, to avoid encouraging the growth of resistant organisms.

Traumatic Ulcer This is an ulcer due to recurring trauma—for example, from a rough broken tooth or an ill fitting denture. The ulcer is generally single, and is situated opposite the causative agent, usually to one side of the front of the tongue It is generally superficial, and tends to heal rapidly once the cause is dealt with.

Tuberculous Ulcer Rarely a tuberculous ulcer occurs, mainly in patients with extensive pulmonary disease It is generally situated near the tip of the tongue and may be painful.

Syphilitic Ulcer Formerly syphilitic lesions of the tongue were common and were important in the differential diagnosis from malignant disease Their infrequency now robs them of clinical importance and the modern reliance on biopsy diagnosis makes it unnecessary to discuss the clinical features.

LEUKOPLAKIA

This condition is characterised by the presence of thick white patches in the mucous membrane of the tongue. It is important as predisposing to carcinoma of the tongue. The patches, which are due to thickening



FIG 158. Leukoplakia of the tongue in a man aged 55 a teetotal non-smoker edentulous and non-syphilitic. Recurring painful erosions and a suspicious area of induration formed the indications for operation, which consisted in removing the affected mucous membrane with a thin layer of the underlying muscles.

of the epithelial layer of the mucous membrane, are raised above the surface of the surrounding mucous membrane like daubs of white paint. They may be limited to the dorsum of the tongue, or may involve the inner aspect of the lips and cheek, and even the palate.

Leukoplakia has been attributed to trauma, smoking, dental sepsis and other diseases but usually no cause is apparent.

Microscopically there is thickening and keratinisation of the superficial layers of the epidermis with lymphocytic infiltration of the dermis.

The treatment is to eliminate the cause. If syphilis is present it should be treated Smoking should be prohibited, and any dental sepsis or source of irritation should be dealt with. A bland mouth wash should be used. Caustics are to be avoided owing to the risk that they might initiate malignancy If these measures fail, and especially if any area of induration is felt under the plaques, the affected portion of mucous membrane with a thin layer of the underlying tissues should be removed Radium treatment is ineffective.

TUMOURS OF THE TONGUE

Simple Tumours. Simple tumours of the tongue are rare. A *papilloma* may occur usually on the dorsum of the tongue. It forms a small warty growth pedunculated or sessile. It should be removed under local or general anæsthesia along with a small ellipse of mucosa. An *angioma* forms a dark red vascular tumour which may occupy the greater part of one side of the tongue. It is treated by electrolysis

Carcinoma of the Tongue

Carcinoma (squamous epithelioma) of the tongue is a common tumour It is seen most often between the ages of 40 and 60 and 90 per cent. of the cases are males.

Its ætiology is obscure. Formerly syphilis was regarded as the most important predisposing factor and some authorities claimed that it was responsible for 60 per cent. of cases or more. Nowadays, however less than 10 per cent. present positive serological tests or other evidence of syphilis. Leukoplakia is a more common antecedent. In some cases recurring trauma by rough irregular teeth leads to malignant proliferation, and it is significant that carcinoma of the tongue is rare in the edentulous Finally the heat of pipe smoke, and irritation by the combustion products contained in the smoke, are factors of some importance.

Pathological Features. Carcinoma of the tongue may start as a superficial warty growth or as a fissure or a deep-seated nodule, but sooner or later it ulcerates and forms a typical malignant ulcer with a small crater a raised, rolled edge, and an indurated base

The tumour is situated most often on the dorsum and towards one lateral edge of the anterior part of the tongue. Less frequently it is at the side of the tongue or on the floor of the mouth close by In the posterior third of the tongue a primary carcinoma is rare, but the tongue may be involved by a growth spreading from the epiglottis, the anterior pillar of the fauces, or the tonsil. The growth spreads locally in the tongue and may involve the floor of the mouth and even the mandible. At an early stage it spreads to lymph glands. Usually those in the digastric triangle are involved first, but a growth near the tip of the tongue may spread to the submental glands while a growth further back may spread directly to glands along the carotid sheath. Distant metastases are rare

Clinical Features. Pain is generally the first symptom either in the tongue or referred to the ear or to the auriculo-temporal distribution at the side of the head. In some cases "earache" is the earliest complaint.

At this early stage the growth is seen as a small ulcer or nodule. Palpation which must never be omitted, reveals its characteristic induration.

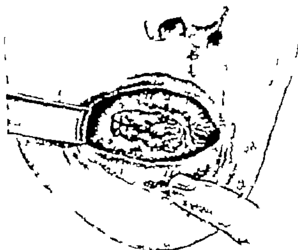


Fig. 159 Carcinoma of the floor of the mouth.

In later stages, now rarely seen, pain and sepsis and incessant salivation cause increasing misery.

Diagnosis. Any nodule or ulcer or fissure of more than a few week's duration should be regarded as malignant until proved otherwise. A biopsy should be performed as a routine.

Treatment. Except in late cases, treatment is required both for the primary growth and for the glands in the neck.

The primary growth may be treated by either radium or operative excision. Radium is to be preferred, as it involves less mutilation, and carries a smaller primary mortality. Before treatment is started, every care is required to reduce the oral sepsis present, and all teeth that are not absolutely healthy should be extracted. The usual method involves the use of radium needles, which are disposed around and deep to the tumour within the substance of the tongue, in such a way as to give a uniform or homogeneous dose to all tumour cells. The needles are inserted under general anaesthesia and the amount of radium is so calculated that the effective "tumour dose" is given over a period of seven days. During this time the patient is kept in bed on a fluid diet, and measures of oral hygiene are instituted.

The cervical glands should be treated three or four weeks after the primary growth. Radiotherapy is not suitable for the treatment of malignant glands, and operative removal is necessary. A block dissection should be performed, clearing out the submental, digastric and carotid triangles on the affected side, and in some cases also the posterior triangle. Formerly removal of the glands was advised even though

none was palpably enlarged but on this matter opinion is now divided, and provided a regular follow up examination is assured many surgeons are content to refrain from operation

The pain of inoperable carcinoma may be alleviated by injecting alcohol into the semilunar (Gasserian) ganglion or into the mandibular division of the trigeminal nerve

CYSTS OF THE TONGUE AND MOUTH

Ranula This sublingual cyst may be present at birth or develop later in life. It is believed to be of branchial origin, or possibly to arise from distension of a mucous or salivary gland



Fig 160 Ranula.

The cyst is situated in the floor of the mouth, to one side of the frenum, and it forms a smooth, rounded, translucent, *blue-grey swelling, sometimes* to be compared with the belly of a frog (hence the name ranula) It tends to increase in size gradually and if large it may cause the tongue to protrude.

The treatment is by operation. The cyst is opened, its watery content evacuated, and the lining membrane then dissected out. Recurrence is common

A *thyroglossal cyst* is much less common here than in the neck (p 303) but like a *lingual thyroid* it may occasionally occur forming a smooth rounded swelling cystic or solid as the case may be, in the depths of the posterior third of the tongue. The swelling may interfere with swallowing and should be removed. If it proves to be a lingual thyroid myxœdema must be prevented by giving thyroid extract.

DISLOCATION OF THE MANDIBLE

Dislocation of the mandible occurs most often in middle-aged females as a result of sudden muscular spasm when the mouth is opened widely in laughing or yawning The dislocation in such cases is usually bilateral Less often dislocation results from a blow on the jaw or from manipulation during anæsthesia, and it is then usually unilateral. In some cases there is a tendency towards recurrent dislocation

In the normal movement of opening the mouth the condyle of the

mandible with its meniscus moves forwards out of the glenoid cavity on to the articular eminence. Dislocation results from sudden contraction of the external pterygoid muscle, which draws the condyle still further forwards over the eminence and into the hollow under cover of the posterior root of the zygoma. The jaw is held in this position by spasm of the masseters and temporal muscles.

The clinical features are readily recognised in bilateral cases There is a sudden pain at the moment of dislocation and the mouth is fixed in the open position and cannot be closed. Speech is indistinct, there is difficulty in swallowing and the saliva dribbles from the mouth. On examination, the chin is seen to be protruded forwards, there is a deep hollow just in front of the tragus, and the condyle of the mandible can be felt as a prominence further forwards.



FIG. 161 Method for reducing a dislocation of the lower jaw

In unilateral cases the features in general are the same as those described above, but are less marked, and the nature of the condition may at first escape notice.

The treatment is to reduce the dislocation. This can generally be accomplished without anæsthesia. The surgeon stands in front of the patient, who is seated on a low stool, and places his thumbs, well protected with adhesive plaster well back on the lower molar teeth. The molars are then pressed firmly downwards and backwards to overcome the muscle spasm and thus the condyles are freed from the articular eminences. When this is done the jaw may slip into place, If not, reduction should be performed under anæsthesia.

After reduction the jaw should be bandaged for a few days. The patient must be instructed to avoid opening the mouth to its full extent for at least a month.

Unreduced Dislocation. A unilateral dislocation does not always cause serious interference with the movement of the jaw and conse-

quently may remain undiagnosed In such cases reduction by manipulation may be tried but is rarely successful after a lapse of more than two months. If manipulation fails the joint should be exposed through a small incision and a further effort at manipulation under direct vision attempted If this also fails the condyle of the mandible should be excised A remarkably good functional result may be secured in this way

INTERNAL DERANGEMENT OF THE TEMPORO-MANDIBULAR JOINT

The intra-articular cartilage which normally follows the condyle of the mandible in its movements may undergo displacement, probably as a result of a sudden spasm of the external pterygoid muscle which is attached to it. The displacement occurs during movement of the jaw and gives rise to a sudden pain with transient locking of the jaw

In most cases the locking is reduced spontaneously or can be overcome without difficulty by closing the jaw while making firm pressure behind the condyle If the displacement recurs the cartilage should be excised.

ARTHRITIS OF THE TEMPORO-MANDIBULAR JOINT

The temporo-mandibular joint is liable to all forms of joint disease, including suppurative arthritis and such chronic affections as gonococcal arthritis and tuberculosis.

Acute disease of the joint may arise, as in the case of other joints as a result of a blood-borne infection but more often follows a local suppuration such as acute parotitis. The bones entering into the joint are diseased, and a sequestrum may form while an abscess may appear over the joint or track down to below the angle of the mandible. Subsequently ankylosis of the joint may result.

Chronic disease of the joint gives rise to pain both in the joint and referred to the ear and the side of the head. The joint is stiff especially in the morning, and a creaking or clicking sensation may be perceived on movement. If the disease is tuberculous a cold abscess tends to form and makes the diagnosis clear In other cases the distinction between rheumatoid and gonococcal arthritis is made on collateral evidence.

The treatment in acute disease is limited to opening any abscess and removing any sequestrum. In chronic disease, if simpler methods fail, the condyle of the mandible should be removed.

FIXATION OF THE MANDIBLE : TRISMUS

Reflex fixation of the mandible may result (apart from tetanus) from any acute inflammatory lesion in the neighbourhood, e.g mumps, parotitis, tonsillitis a gumboil or an unerupted molar tooth.

Permanent fixation may result from arthritis of the temporo-mandibular joint or an untreated dislocation or from contracture of the soft tissues by an old burn. Lastly it may result from the presence of a carcinoma of the inner aspect of the cheek or the tonsillar region.

The treatment varies according to the cause. If the lesion is an arthritis the condyle of the mandible should be removed. If the fixation is due to old scarring the range of movement may be increased by removing sufficient bone near the angle of the mandible to form a false joint at this point.

Gum boil Osteomyelitis of Jaw A gum-boil is an infective process secondary to dental infection. It starts as an inflammatory swelling of the periodontal membrane and spreads to the adjacent periosteum. It may go on to form an alveolar abscess which may point at the gum or through the skin below the jaw It must be diagnosed from actinomycosis X ray examination of the tooth roots, and bacteriological examination of the pus establishes the diagnosis

More extensive osteomyelitis of the mandible with widespread necrosis was seen in debilitated persons in patients undergoing anti syphilitic treatment by arsenic and bismuth and in phosphorus workers All these forms are now rare.

TUMOURS OF THE GUMS

A simple tumour of the gums is known as an *Epulis* Three types of epulis are described *The giant-cell epulis* is the commonest. It originates from the mucoperiosteum of the alveolar margin generally between two teeth, and it grows slowly to form a pedunculated tumour which may eventually attain the size of a raspberry The tumour is deep red in colour and very vascular Bleeding is therefore a common feature. Microscopically the tumour is characterised by the presence of giant cells similar to those in the "giant-cell tumour" of bone. The treatment is to remove the tumour along with a small wedge of mucoperiosteum and of the underlying alveolar margin. *The fibrous epulis* is similar in all respects, except that microscopically it has the character of a simple fibroma. *The angiomatous epulis* is a sessile, vascular angioma which may be excised or treated by electrolysis.

In addition to these simple tumours the gums may be the site of squamous epithelioma, which may originate at the root of a septic tooth, or may spread to the gum from the floor of the mouth or palate.

TUMOURS OF THE MAXILLA

The maxilla may be involved by carcinoma, sarcoma, giant-cell tumour and rarely such simple growths as fibroma, chondroma or osteoma.

Carcinoma of the maxilla generally originates in the ciliated columnar mucous membrane of the maxillary antrum. It is a growth of considerable local malignancy which fills the antrum and invades the bone in all directions. It only metastasises at a late stage.

Sarcoma of the maxilla is generally a fibro-sarcoma. It may arise from any aspect of the bone, and may project under the cheek, into the orbit, the nasal cavity or the mouth, or posteriorly towards the pterygoid fossa. It invades extensively but does not metastasise until late.

Giant-cell tumour of the maxilla is generally regarded as a benign tumour although it infiltrates locally to a considerable extent. It starts within the bone and slowly enlarges, expanding the bone around it, until eventually only a thin shell is left.

The clinical features of the various tumours of the maxilla are very similar All tend to cause pain referred along the branches of the maxillary nerve. If the antrum is involved, a low-grade infection often supervenes. Later the tumour may obstruct the nostril or the tear duct, or may displace the eyeball and lead to diplopia. On examination, the tumour may cause a visible bulging of the cheek, or be seen growing through the palate, through the alveolar process or in the canine fossa.

The diagnosis is to be made from a simple chronic infection of the antrum, from an odontome, or from rare simple enlargements of the maxilla allied to osteitis fibrosá. Radiographic examination is valuable in making the diagnosis, and may also serve to distinguish one form of tumour from another In doubtful cases biopsy is advisable.

The treatment of a tumour of the maxilla, excluding rare simple tumours which can be enucleated, is by a combination of surgery and radium. The first step is to gain access by removing bone from the canine fossa, alveolar margin or palate, and to remove as much of the tumour as is possible by this route. The next step which is carried out a week or so later is to apply radium in the form of an obturator moulded to fit into the cavity left from the operation If the treatment is successful the cavity is eventually lined with granulation tissue and a dental obturator can then be fitted to remedy the deformity and prevent falling in of the cheek.

TUMOURS OF THE MANDIBLE

The mandible may be involved by giant-cell tumour or rarely by sarcoma. A carcinoma from the gum or floor of mouth may involve the mandible, but other types of tumour are very rare.

Giant-cell tumour of the mandible generally originates in the ramus of the bone, and grows slowly forming a globular tumour which expands the bone to a thin shell. This tumour is to be diagnosed from an odontome, which resembles it closely In a doubtful case a biopsy should be performed.

The treatment of a giant-cell tumour is by conservative surgical resection followed by radium. The gum is incised over the tumour its bony shell within the mouth is removed and the tumour tissue is evacuated by means of a sharp spoon. The resulting cavity is packed open. A few weeks later radium may be introduced into the cavity to destroy any remaining cells

Sarcoma of the mandible is generally of the periosteal type and is highly malignant. It forms a spindle shaped tumour which grows rapidly and invades extensively The treatment is preferably by exposure to radium. Failing this, the bone may be removed but this procedure gives rise to great disability unless the lower rim of the bone can be preserved to maintain the integrity of the jaw

ODONTOMES

The teeth are partly of epidermal, partly of mesodermal origin In early foetal life cells from the basal layer of the epithelium of the gum grow down into the subjacent connective tissue and form enamel organs, which give rise to the enamel covering the crowns of the teeth the remaining parts of the teeth, namely the dentine and the pulp are derived from specialised connective tissue cells, or odontoblasts. Odontomes—tumours or cysts of dental origin—may arise from the

whole tooth germ or from either the enamel organ or the connective tissue part alone

The only common odontomes in man are of epithelial origin, and of these there are three types. The *enamel-cell tumour* (ameloblastoma or adamantinoma) originates as a solid tumour composed of lobules of cells of basal epithelial type. The cells in the centres of the lobules degenerate and liquefy and thus cysts are formed which increase in size and



Fig. 162. Odontome of many years duration.

eventually occupy most of the tumour The *follicular odontome or dentigerous cyst* forms a cavity generally within the mandible, containing the crown of an undeveloped unerupted tooth. Corresponding to this there is a gap in the permanent teeth, generally in the molar region. The *dental cyst* is generally a small cavity containing mucoid fluid and cholesterol *débris* attached to the root of a carious tooth. It is apt to be mistaken for a root abscess, but can be distinguished on microscopic examination by the presence of an epithelial lining membrane.

Odontomes *appear most often* in adolescence or early adult life,



Fig 163. X ray showing odontome of maxilla from case seen in Fig 162. A *large cyst replaces the bone. The incisor* teeth are normally formed but displaced by the swelling

and they are far more common in the mandible than in the maxilla. Generally, they grow slowly and form rounded, cystic swellings, which expand the overlying bone to a thin shell. In some cases one of the permanent teeth is missing and can be demonstrated, by X ray examination within the cyst in others the teeth are intact at first, though they may loosen and fall out as the cyst enlarges.

The treatment of an odontome is by operation. The gum over the swelling is incised the cyst is opened, and its contents evacuated The lining membrane is then dissected out or avulsed. In larger odontomes of enamel-cell type as much tumour tissue as possible is removed with a sharp spoon and subsequently radium is introduced into the cavity

AFFECTIONS OF THE SALIVARY GLANDS

While it is convenient to take the salivary glands as a group, it should be noted that the incidence of disease in the parotid and submaxillary glands is quite dissimilar There is no disease in the submaxillary gland analagous to acute parotitis. Tumours are not uncommon in the parotid but excessively rare in the submaxillary whereas the opposite is true of calculi.

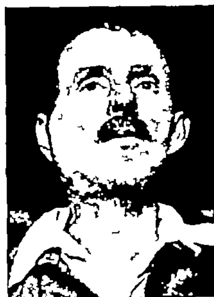


FIG. 164. Acute parotitis secondary to pyorrhœa.

Suppurative Parotitis. This acute infective condition may occur as a primary disease, but much more often it develops as a post-operative complication or in the terminal stages of a debilitating illness. The infection is believed to reach the gland along its duct from the mouth, and it is thought that oral sepsis, impaired secretion of saliva, and the dirty dry mouth of severe toxæmia are the essential predisposing factors.

In typical cases the disease generally starts abruptly The gland becomes swollen and brawny and a severe throbbing pain is felt. The

overlying skin is red and œdematous. The mouth is opened with difficulty and there is pain on swallowing

While the symptoms described above are seen in typical cases they are sometimes absent, especially in persons in the terminal stages of severe infections, and the only sign may be a localised swelling of the gland, often bilateral. In such cases, in the absence of an inflammatory reaction parotitis must be regarded as of grave import.

The treatment is by penicillin, which usually brings about a speedy cure. If pus forms, a small incision is made over the most prominent part of the swelling usually near the angle of the mandible, and is made parallel to the line of the branches of the facial nerve. A sinus forceps is then thrust deeply and the abscess opened by Hilton's method to avoid the risk of injuring the nerves

Tumours of the Parotid Gland. *Mixed Tumour* This is the commonest tumour It generally appears in early adult life, is painless and forms a firm smooth and rounded lump within the superficial part of the

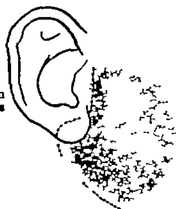


FIG. 165. Mixed tumour of parotid gland. The common site of the swelling is indicated Dotted line shows line of incision.

gland, lying either in the face over the masseter muscle, or behind the jaw Since it lies deep to the dense fascia overlying the gland, the tumour does not project much above the surface at this stage. It grows slowly over many months and years, and may eventually reach considerable size, forming a prominent deformity Generally it is quite benign but occasionally it undergoes malignant change. Microscopically the tumour is an epithelial growth, consisting of cuboidal or flattened epithelial cells arranged in strands or acini, and embedded in a copious connective tissue stroma which generally presents extensive mucoid degeneration. It owes its title "mixed tumour" (a misnomer) to the fact that the mucinous matrix may closely resemble, and was formerly mistaken for cartilage.

The treatment should be by operation as radiotherapy has little effect. Formerly the usual procedure was to *shell out* the tumour from within its capsule, but there was a great liability to recurrence. It is now recognised that the capsule is a false one and that nodules of tumour tissue often extend beyond it, so the operation now favoured is a *partial parotidectomy* in which the tumour is removed along with a thin zone of normal tissue. There is a considerable risk of damage to

the facial nerve, to the parotid duct and the auriculo-temporal nerve, so the services of a skilled surgeon are desirable.

The incision is made down in front of the ear and below it backwards to the base of the mastoid and then obliquely down into the neck. The skin flap is dissected forwards. The dissection is deepened through vascular adherent tissue to expose the facial nerve as it emerges from the stylo mastoid foramen, and the nerve and its branches are traced forwards into the gland. The tumour can then be removed safely

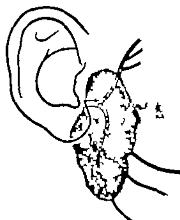


FIG. 106. Facial nerve traversing parotid gland.

Carcinoma. This generally occurs in elderly persons. It may be malignant from the start or arise in a mixed cell tumour It infiltrates widely through the parotid gland and adjacent tissues and it may spread to local lymph sites but never to a distance. At first it forms a nondescript firm lump in the gland, readily mistaken for a mixed tumour Later its hardness and fixation become apparent, and involvement of the nerve leads to facial paresis

The treatment should be by operation if at all possible, since the tumour is but little responsive to radiotherapy The parotid gland is exposed by the means described above. If there is doubt as to the diagnosis a frozen section should be examined. The whole parotid gland is then removed The facial nerve must be sacrificed

Parotid Fistula. After operations on the parotid gland, and occasionally after accidental wounds, saliva may escape and form a collection deep in the tissues If the leakage comes from the gland itself, it suffices to aspirate the collection a few times and the leak then closes spontaneously But if the duct is damaged, it often proceeds to cause *external salivary fistula.* Saliva then drips continuously over the face and pours out in a stream during meals.

Sometimes the fistula heals spontaneously in a few weeks. If not, the gland should be exposed by re-opening the wound and the fistula traced to its source. The wound is then deepened into the mouth, so as to convert the external fistula into an internal one. If this fails a heavy dose of radiotherapy should be applied, to suppress the parotid secretions for a few months to allow the fistula to close.

Auriculo-temporal syndrome. In this condition, which almost invariably occurs as a sequel to operation, a patch of skin corresponding

to the distribution of the auriculo-temporal nerve becomes liable to excessive sweating, particularly at meal times (gustatory sweating) The sweat glands of the face are supplied by sympathetic (but cholinergic) fibres carried along the branches of the trigeminal nerve, and the accepted explanation is that the lesion is due to damage to the nerve followed by axonal regeneration along different axon sheaths. The condition is annoying but fortunately in most cases it tends to clear up in a few months.

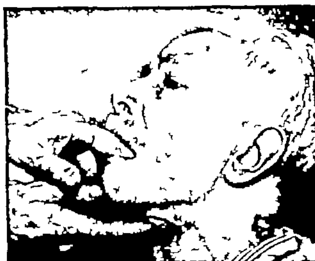


FIG 167 Palpating submaxillary salivary gland.

Parotid calculus. Calculus formation is rare in this situation compared to the submaxillary gland The symptoms are similar The calculus usually lies in the duct. It can be seen on X ray examination. If possible it should be removed by way of the mouth

Submaxillary Salivary Calculus. Calculus formation is common in this situation, probably owing partly to the more viscid, mucoid character of the saliva, the tendency to stagnation within the dependent gland, and the liability to infection from the floor of the mouth. The



FIG. 168 X-ray of submaxillary salivary calculus.

calculus is composed of calcium carbonate and phosphate It generally lies in the duct of the submaxillary gland under the floor of the mouth to one side of the frenum It is generally elongated or fusiform, and it may attain the size of a date stone. Less often the calculus forms within the gland itself

The calculus gives rise to recurring obstruction of the duct in which it lies, and leads to attacks of painful swelling of the submaxillary gland. The swelling is most obvious at meals, and can be induced by sucking saliva stimulating foods, such as a lemon. In the course of time the gland becomes permanently enlarged.

It is generally possible to palpate the calculus in the floor of the mouth, and a probe passed up the duct may be felt to grate upon it. The diagnosis is confirmed by radiography

If the calculus is readily accessible within the duct, and provided that the gland is not permanently infected or fibrotic, it is possible to remove the stone very easily by way of the mouth, after incising through the mucous membrane over the stone (if palpable) or over a probe inserted into the duct. No attempt is made to suture the incision. If the calculus is more deeply placed or the gland permanently enlarged the whole gland and the duct should be removed through an incision in the skin of the neck over the digastric triangle.

CHAPTER 20

THE NECK

INJURIES TO THE NECK

Cut Throat. There are certain differences between suicidal and homicidal cut throat, which are well known for their medico-legal importance.

In suicidal cases the cut generally starts on the left side (in right handed persons) and usually it is directed obliquely downwards and to the right. It is deep at first, and generally tapers as it crosses the neck. The first attempt is often of a tentative character and there may be several superficial cuts as well as the main wound. In suicidal cases, moreover the head is generally held well back, and consequently the great vessels are retracted deeply under cover of the sternomastoid muscles and may escape injury even though the wound is deep

In homicidal cases, on the other hand, there is generally a single deep cut, passing transversely across the neck and often dividing the main vessels.

The wound is situated most often at the level of the thyro-hyoid membrane, but it may be above or below this point. The structures liable to damage vary according to the level.

(1) Above the hyoid bone the wound divides the muscles of the tongue and may open into the mouth. The base of the tongue and epiglottis, if partially severed, may fall back and occlude the upper aperture of the larynx. Severe bleeding may result from division of the lingual or facial arteries or their branches.

(2) Through the thyro-hyoid membrane the pharynx is opened and the epiglottis may be wounded, and this may lead to dyspnœa. The depressor muscles of the hyoid bone are divided and dysphagia and dysphonia may result. The lingual, superior thyroid, and even the carotid arteries may be opened.

(3) Below the thyro-hyoid membrane the larynx is opened either through the thyroid cartilage or below that level. Acute dyspnœa occurs immediately and is accompanied by bouts of coughing owing to the entrance of blood into the air passages. Aphonia usually results. Bleeding is generally severe, from damage to the superior thyroid vessels or the carotids or internal jugular vein.

Treatment. The first indication is to arrest hæmorrhage, the second to relieve urgent dyspnœa or impending suffocation if present. An emergency tracheotomy may be required.

When these first-aid measures have been applied, the patient may be moved to hospital, and the subsequent treatment of the wound carried out thoroughly if possible under general anæsthesia Preliminary measures to combat shock may be required

After the wound has been cleansed and any obviously contaminated tissues removed the various structures that have been damaged are repaired by suture. Generally the damage is less extensive than appears at first sight. If the larynx has been opened it is usually advisable to insert a laryngotomy tube or to perform tracheotomy A wound in the pharynx is closed by suture and the muscles and skin are then sutured with provision for ample drainage. In a few cases, where there is an extensive wound of the pharynx, gastrostomy should be performed

Fracture of the Hyoid Bone. The hyoid bone is liable to fracture in throttling strangling or hanging Rarely it has been injured by a direct blow The fracture is generally at the junction of the body with the greater cornu The injury causes severe pain and may lead to urgent dyspnœa and marked dysphonia. If the displaced fragment of bone pierces the mucous membrane, blood may escape into the air passages and air may be forced into the tissues, causing respectively hæmoptysis and interstitial emphysema

The treatment is to perform tracheotomy if the dyspnœa is severe. Later the fragments should be manipulated into position by a finger passed through the mouth and a collar of poroplastic felt or plaster of Paris applied

Fracture of the Larynx. The thyroid or cricoid cartilages, or even the trachea, may be fractured as a result of severe violence. Urgent dyspnœa results, either at once or a few hours later when œdema of the glottis supervenes. If the mucous membrane is torn, hæmoptysis and interstitial emphysema may result The treatment is to perform immediate tracheotomy

TORTICOLLIS (WRY NECK)

Three types of wry neck deformity are recognised—the congenital acute and spasmodic.

Congenital Wry neck. This condition was formerly thought to be due to a birth injury—a sequel to the so-called *sternomastoid tumour* a mass of granulation tissue and degenerated muscle fibres, which is believed to be a result of venous infarction of the muscle due to obstruction of its venous circulation during birth. More probably it is the result of a congenital aplasia affecting the sternomastoid and, to a lesser extent, other tissues of the neck.

The deformity is not so apparent in the young baby and generally it is first noticed when the child is a few years old when the muscle fails to keep pace with the growing neck.

In the fully developed torticollis the affected sternomastoid muscle stands out as a prominent cord of tissue. The head is flexed, bent towards the affected side and rotated towards the opposite side, while its movements are considerably limited.

If the deformity is left untreated until adolescence, secondary adaptive and compensatory changes occur All the soft tissues on the

affected side become short, including muscles, fasciæ and blood vessels The face and skull become asymmetrical and compensatory scoliosis develops.

Treatment The treatment is by operation which should not be delayed The operation consists in gaining wide exposure of the affected side of the neck and in dividing all contracted structures including the deep fascia, the carotid sheath and the connective tissues of the neck as well as the contracted muscle. In severe cases the muscle may be removed in its entirety to ensure freedom from recurrence.



Fig. 109. Torticollis in a boy aged 10. There was no history in this case to indicate a birth injury nor had any swelling been noted in the neck in infancy Note the facial hemi atrophy

After operation, careful training and exercises must be instituted and maintained for a long time. A poroplastic collar may be worn, fitting tightly on the affected side from the mastoid process to the root of the neck so as to press against these structures and open out the space between them.

Acute Wry-neck. A wry neck may develop suddenly in association with pain in the side of the neck and shoulder region. Sometimes it appears to follow a chill or exposure to a draught of cold air and it may be attributed to fibrositis. It may be caused by a lesion of a cervical intervertebral disc (p 300)

Spasmodic Wry-neck. This is a rare condition, practically limited to adults of neurotic disposition and characterised by clonic contractions affecting the sternomastoid and trapezius muscles, and sometimes the deep cervical muscles of the opposite side. In rare cases it may be so severe as to interfere with sleep

The treatment is to administer sedatives. Operation may be advised in exceptional cases, with division of the accessory nerve on the one side and of the muscular branches of the cervical plexus on the other

CERVICAL RIB THORACIC OUTLET SYNDROME

The anterior tubercle of the transverse process of the seventh cervical vertebra is a homologue of the thoracic ribs, and in 1 or 2 per cent. of persons it enlarges to form a cervical rib usually a stumpy

process ending in a strong fibrous cord which continues forward and is attached to the first thoracic rib

In the great majority of cases a cervical rib is entirely symptomless, but occasionally there are symptoms due to pressure on the lowest cord of the brachial plexus (which arches over the rib on its fibrous prolongation) or even to pressure on the subclavian artery Pressure on the *plexus may give rise to pain and tingling down the ulnar side of* the forearm and paresis of the intrinsic muscles of the hand. This condition must be diagnosed from the nerve lesions of cervical spondylitis Pressure on the subclavian artery in rare cases leads to aneurysmal dilatation of that vessel. Thrombosis may follow, leading to ischæmia of the limb and even to gangrene of the digits

The presence of a cervical rib can readily be confirmed by X ray examination, but great caution must be taken in attributing symptoms to it. Apart from cervical spondylosis, progressive muscular atrophy and other diseases of the nervous system must be excluded, and also the carpal tunnel syndrome (p 168) Only in rare cases is it necessary to advise operative removal of the rib

Prolapse of Cervical Disc Cervical Spondylosis

Degeneration of cervical intervertebral discs is now recognised as a common cause of pain and other symptoms related to the upper



FIG. 170 Spondylitis of cervical spine.

extremity The degenerating disc leads to bony exostoses which project from the edges of the vertebral bodies and compress the nerves as they lie in the intervertebral foramina. The 5th, 6th and 7th nerves may be involved The pain is referred to shoulder arm and hand and also sometimes to the occipital region, without restriction to the territory of any particular nerve It is aggravated by coughing and may be worse at night. There may be paræsthesiæ and slight weakness of the triceps, wrist extensors or small muscles of the hand. In acute phases there is marked stiffness of the neck, and there may be tender points in the muscles suggesting fibrositis

The diagnosis is to be made from the thoracic outlet syndrome (cervical rib) and from the carpal tunnel syndrome. X ray examination reveals narrowing of the intervertebral spaces and lipping of the vertebral bodies. The treatment is to immobilise the neck in the position of greatest comfort, using a felt or cardboard collar Intermittent traction is helpful, by a rocking bed or similar machine in which traction equal to 30 lb weight is applied at fifteen second intervals through a special harness applied to the head.

CYSTS AND FISTULAS IN THE NECK

Branchial Cyst. The neck develops from a series of arches, the branchial arches. Each consists of a bar of cartilage, a muscle, nerve and artery



FIG. 171 Branchial cyst of three years' duration in girl aged 17

The arches and the intervening spaces are clothed externally by ectoderm (skin), and internally by entoderm (pharyngeal lining membrane) Between the arches ectoderm and entoderm are in contact, so that depressions are formed on each surface, the branchial clefts externally and the branchial pouches internally The first cleft forms

the external ear, the first pouch the middle ear and Eustachian tube. The second cleft is normally obliterated, while the second pouch forms *the tonsillar fossa.*

A branchial cyst arises from epithelial cells derived from rudiments of the obliterated second branchial cleft.

The cyst appears in adolescents or young adults, especially women, and grows slowly forming a tense, rounded, mobile swelling, situated deep to the sternomastoid muscle a little below the level of the angle of the jaw

The diagnosis is to be made from a tuberculous gland, a cold abscess or a lipoma. It may be confirmed by puncturing the cyst with a hollow needle. *In a branchial cyst the fluid contains cholesterol* crystals, which may be recognised as flat colourless rhombs with one re-entrant angle.

The treatment is to remove the cyst, generally a simple procedure as the cyst is non adherent and can be enucleated. Occasionally it is *adherent to the internal jugular vein, and in rare cases it extends deeply* between the carotid bifurcation towards the pharynx

Branchial Fistula. A branchial fistula is generally believed to develop from the second cleft. In normal development the second arch enlarges rapidly and comes to overlie the third, so that the intervening second



FIG. 172. Branchial fistula.

cleft becomes elongated and lies obliquely in the neck, forming the *cervical sinus* Failure in the normal obliteration of the cervical sinus *is regarded as the cause of branchial fistula.* It may be noted, however that a branchial fistula has also been attributed to persistence of the thymo-pharyngeal duct.

A branchial fistula extends from the tonsillar region of the pharynx (a part corresponding to the second branchial pouch) down to the lower part of the neck. It passes between the external carotid artery (the artery to the second arch) and the internal carotid artery (the artery *to the third arch) close to their bifurcation.*

The lower opening of the fistula is generally situated an inch or so above the sternoclavicular joint at the anterior border of the sternomastoid The fistula is present at birth or appears in infancy It tends to close periodically and later after signs of low grade inflammation, to re-open and discharge purulent fluid.

The treatment is to dissect out the track and remove it. Complete excision is necessary to obviate recurrence.

Thyroglossal Cyst. The thyroid gland originates in the floor of the primitive mouth cavity at a point corresponding to the position of the foramen cæcum in the midline of the posterior third of the tongue From thence it descends through the muscles of the tongue to the hyoid bone and then down to its eventual position in the neck. The track formed by the descending gland is the thyroglossal duct. Normally it is obliterated A thyroglossal cyst results from persistence of some part of the duct.



Fig 173. Thyroglossal cyst.

It was formerly described as a *tubulodermoid* It may appear at any age, and is commonest in children and adolescents.

Very rarely the cyst arises from the upper part of the duct and lie in the substance of the tongue (p 286) Much more often it arises from the lower part of the duct and appears in the neck below the level of the bone and in or close to the midline. It is generally attached to the hyoid by a fibrous cord, which may be palpable. The diagnosis is to be made from an adenoma of the thyroid isthmus or from the very rare *cystic subhyoid bursa* *The treatment is to excise the cyst along* with the fibrous cord. The latter should be traced upwards to its termination, even as far as the foramen cæcum. The central segment of the hyoid bone should be removed to facilitate complete excision of the track. There is a tendency to recurrence, even after an apparently thorough excision.

Thyroglossal Fistula. Nearly always a fistula of the thyroglossal duct is due to suppuration in and rupture of a thyroglossal cyst, or follows incomplete surgical removal of a cyst. It should be excised, along with the fibrous tract from which it springs, as described for thyroglossal cyst.

Cystic Hygroma. This is a lymphangioma of congenital origin, and it may be seen in early infancy although more commonly it is small at first, and only attracts attention during childhood. As it enlarges the cyst extends deeply in the neck, sending prolongations between the muscles and even into the mediastinum.

Clinically it gives rise to a large soft painless lobulated swelling at the root of the neck. It is clear on transillumination. The overlying skin may be healthy or thin and blue. Attacks of subacute inflammation are common owing to the presence of lymphoid tissue in the wall of the cyst.

The treatment is to remove the cyst if feasible. If the cyst is adherent, or ramifies extensively, it is wiser to attempt to obliterate it by sclerosing solutions such as those used for varicose veins

Dermoid Cyst. Ordinary sequestration or inclusion dermoids are seen occasionally in the midline of the tongue or neck. Such a cyst occurs in childhood and forms a small rounded swelling lying superficially painless, mobile, and not attached to the skin or the deeper structures It may be enucleated and removed.

Cystic Subhyoid Bursa The subhyoid bursa lies between the thyrohyoid membrane and the posterior aspect of the hyoid bone. Rarely it becomes distended with fluid and gives rise to a small, oval, elastic swelling, lying with its long axis transversely immediately below the hyoid bone. It is to be diagnosed from a thyroglossal cyst. The treatment is to excise it.

Laryngocele (*Cervical Aerocele*) This is a rare cyst containing air and communicating with the larynx. It is due to herniation of the mucous membrane of the larynx, which explains its especial occurrence in the players of wind instruments in glass-blowers and in sufferers from chronic bronchitis.

The cyst first lies within the cartilaginous framework of the larynx and forms a tense swelling above one vocal cord. At this stage it may cause dysphonia or even dysphagia. Later it is extruded through the thyro-hyoid membrane, and in severe cases it may extend as far as the clavicle, forming a painless cyst which enlarges on forced respiration and empties with a gurgle on pressure.

AFFECTIONS OF CERVICAL LYMPH GLANDS

Acute Lymphadenitis

Acute inflammation of the lymph glands of the neck generally occurs as a sequel to an infection of the scalp teeth, tonsils or pharynx. The affected glands are swollen and painful and very tender to touch.



FIG. 174. Large abscess in neck, the result of acute lymphadenitis secondary to tonsillitis. Note the acute wry neck deformity

If the primary focus is promptly treated the inflammation may resolve, but sometimes it proceeds to suppuration.

Suppuration in the glands is indicated by increase in the pain which assumes a throbbing character The glands become fused together and to the surrounding tissues, and nearly always there are marked tenderness and hyperaesthesia. The overlying skin becomes reddened and

thinned and eventually if untreated, the skin gives way and pus is discharged.

The constitutional effects vary greatly Almost always the temperature is raised, though sometimes it may not rise above 100° F

The diagnosis is obvious in most cases. In low-grade infections with little pyrexia the question of tuberculosis may arise, but the progress of the disease makes the distinction clear

The treatment in the early stages should be directed mainly to the primary focus, while hot fomentations may be applied to the neck If suppuration occurs the abscess must be opened and drained

Tuberculous Glands in the Neck

Glands in the neck may be infected by blood borne bacilli (when multiple glands are affected) or by bacilli gaining access through the tonsil. In this latter case, the main incidence of the disease falls upon one gland or a small group of glands, especially the tonsillar or jugulo-digastric gland, which lies in the angle between the common facial vein and the internal jugular vein, and is situated deep to the sternomastoid muscle a little way below the angle of the jaw (Fig 175)

The affected gland may be enlarged to the size of a walnut, while



FIG. 175. Tuberculous lymph glands. The jugulo-digastric gland was the size of a walnut and extensively caseous. There was a smaller gland a little below it. The tonsils were diseased. No wide-spread tuberculosis and but little impairment of health. Treatment by operative removal of the two glands.



FIG. 176. Tuberculous lymph glands in left digastric triangle and lower part of neck associated with glands in the axillæ and resulting from an exacerbation of long-standing pulmonary disease. Conservative treatment.

other smaller glands are present in the vicinity The glands become fixed by adhesions to each other and the surrounding tissues. Often the disease proceeds to caseation and a cold abscess may form. If untreated, *the abscess may come to the surface and give rise to a sinus.*

The treatment is by general measures (p 101) and by local methods which vary according to the local state. If the disease is limited to small groups of glands they may be *shelled out intact. Later* if the glands are caseous, or if a cold abscess is present, it suffices to evacuate the pus and caseous matter and curette the resulting cavity The tonsils may require to be removed later

Lymphadenoma (Hodgkin's Disease)

The neck is a common site for Hodgkin s disease. Most often the glands first affected are situated low in the posterior triangle. Later the disease spreads to other groups of glands in the neck and to other regions. The affected glands are considerably enlarged painless, elastic and of fleshy consistency They may diminish in size from time to time, but show a general tendency to enlarge. There is no peri-adenitis, and until a late stage the glands are discrete and freely mobile. The *other features of Hodgkin s disease (p 99) may be present.*

The diagnosis is to be made from tuberculous glands, leukæmia and related conditions, lymphosarcoma and secondary growths. In doubtful cases biopsy should be performed.

Metastatic Carcinoma

Metastatic carcinoma is common in the glands of the neck, secondary to epithelioma of the upper air and food passages. The disease first attacks the glands along the main path of lymph drainage from the primary growth, and later spreads to other glands more distant. The glands of the upper deep cervical group *situated along the upper part* of the carotid sheath, are usually the first to be involved The affected glands form very hard swellings which become fixed to each other and invade the adjacent tissues at an early stage.

The diagnosis is to be made from tuberculous glands. Hodgkin s disease and from branchiogenic carcinoma. The step of greatest value in the diagnosis is to demonstrate the primary growth, which may be quite small and symptom free, especially if situated in the pyriform fossa.

The treatment in an early case may be by operation which involves a block dissection of the neck.

Branchiogenic Carcinoma

This rare tumour is believed to arise from epithelial rests originating from one of the branchial clefts It usually occurs in elderly men

The tumour generally arises in close relation to the carotid bifurcation and it spreads diffusely forming a hard mass which invades the muscles and ultimately may implicate the skin. It is to be diagnosed from a carcinomatous metastasis secondary to a growth in the mouth, tongue, *maxilla*, *larynx* or pharynx. In making the diagnosis it is important to examine these regions with particular care, especially the pyriform fossæ and the post-cricoid region.

Lymphosarcoma must also be excluded Biopsy is usually necessary to confirm the diagnosis

The treatment is by radium or X rays. At a very early stage it may be possible to attempt operative removal.



FIG. 177 Branchiogenic carcinoma in a man aged 76 There was a painless swelling, of six months duration, partly cystic, very adherent, and enveloping the bifurcation of the carotids.

Tumours of the Carotid Body

The carotid body is a small gland or paraganglion of unknown function situated in the saddle of the carotid bifurcation. A tumour of the carotid body is a rare growth which is known variously as an endothelioma, para ganglioma, chromaffinoma (from its affinity for chromate stains) and lastly as "potato tumour" from its naked-eye appearance.

The tumour arises mainly in adults It is generally of benign character and slow growth though in some cases it becomes malignant. As it grows the tumour tends to encircle the great vessels and may envelop them com pletely It is generally painless and symptomless but occasionally it causes attacks of cerebral ischaemia from pressure on the vessels

At operation an attempt may be made to remove the tumour but not if this would involve carotid ligation owing to the risk of cerebral thrombosis

CHAPTER 27

THE THYROID AND PARATHYROID GLANDS

THE thyroid gland secretes thyroxin, an iodine rich hormone which exercises an important influence over growth and metabolism. The gland is itself influenced by the thyrotropic hormone produced by the anterior lobe of the pituitary gland.

The effects of the thyroid hormone are indicated by the changes that occur in diseases of the gland. In myxœdema, when the thyroid secretion is defective, the skin becomes dry and scaly, the hair falls out, nervous responses are sluggish, the mentality is impaired, the temperature is subnormal and the whole metabolism is depressed In *cretinism (congenital hypothyroidism) there are, in addition, marked* impairment of the intelligence and interference with the growth of bone, leading to dwarfism.

In hyperthyroidism, on the other hand, the metabolic activities of the whole body are accelerated, and in addition there are changes, such as tachycardia, tremors, nervousness, weakness, flushing of the skin and exophthalmos, which may be regarded as due to increased excitability of the sympathetic nervous system.

Thyroxin, an iodine-containing protein, is a product of the cubical cells lining the acini of the thyroid gland. When secreted by these cells it may be discharged directly into the blood vessels surrounding the acini for immediate utilisation, or it may be stored within the acini as a constituent of the colloid The amount of thyroxin stored may be *judged by the amount and staining qualities of the colloid.* Thus in hyperthyroidism, when excessive amounts of thyroxin are being poured directly into the blood stream and none is being stored the colloid is scanty and poorly stained, whereas in certain forms of simple goitre, when thyroxin is being stored in excess, the colloid is present in large amount and stains well.

Radio-iodine (the iodine isotope, I^{131}) may be used as a test of thyroid function, and is useful in the diagnosis of toxic goitre on the one hand and myxœdema on the other The usual tracer dose of 25 microcuries is given by mouth. Normally about 30 per cent. is taken up by the thyroid gland within a few hours, the remainder being excreted in the urine. During this period the blood level falls progressively In hyperthyroidism from 40 to 90 per cent. is taken up by the gland and correspondingly less is excreted. The blood level, which falls during the first few hours, shows a secondary rise as the active gland pours out fresh isotope-containing thyroxine. In hypothyroidism, by contrast, less than 5 per cent. is taken up by the gland while 70 to 90 per cent. is excreted in the urine. As practical methods of diagnosis, three kinds of

estimation are in current use: (1) The concentration in the thyroid gland as measured by a Geiger counter applied to the neck. The amount taken up in four hours is estimated, or a clearance rate based on the blood level may be calculated (2) The excretion in the urine. The amounts of I^{131} contained in urine secreted 0 to 8 hours, 8 to 24 hours and 24 to 48 hours provide data for an arbitrary formula. (3) The blood level after 48 hours. This gives an estimate of the thyroxin level and is the best single test of thyroid activity

Endemic and Sporadic Goitre. It has long been known that goitre is endemic in certain areas, notably the Himalayas and the Swiss alps. Marco-Polo, in his journey to Peking observed that in certain valleys of Turkestan there were many goitrous subjects, while in adjacent valleys there were none, and he correctly attributed it to differences in the character of the water In England the Derbyshire district formerly harboured the disease (Derbyshire neck) while in North America it was common in the region of the great lakes. All these geographical tendencies are now being removed by iodising the salt.

Sporadic goitre may occur in any part of the world There is no quantitative lack of iodine in these cases, but probably in most there is a relative deficiency due to impairment in the absorption of iodine from the alimentary tract, or alternatively to a demand for more iodine than is available in the diet. Absorption of iodine from the intestinal tract is impaired by a diet rich in calcium or in fat, and possibly by the presence of specific substances such as are found in certain foodstuffs, e.g cabbages.

SIMPLE GOITRE

At puberty, during pregnancy and to a minor degree during every menstrual period, the thyroid gland undergoes physiological hyperplasia in response to the increased metabolic activities of the tissues at those times. The gland is enlarged, and microscopic examination shows proliferation of the lining cells of the acini with diminished storage of iodo colloid.

Normally the enlargement is but slight, and the gland undergoes involution when the period of stress is over and reverts to normal. If, however the stimulus to proliferation is excessive, or if there is a deficiency of available iodine, the enlargement is more marked and the subsequent involution is abnormal. These variations from the normal constitute the various forms of simple goitre. In some cases, as indicated above, the main or sole cause is a deficiency of iodine, due either to lack of iodine in the food or water or to impaired absorption from the alimentary tract. In other cases the disease may be attributed to excessive mental or psychical strain, especially at puberty, or to impairment of the general health, e.g as a result of focal infection

Simple goitre generally causes no symptoms either of hyperthyroidism or of hypothyroidism. In virtue of its size, however it may cause certain local pressure effects. The trachea may be compressed from side to side (scabbard trachea) or may undergo softening so that

it tends to collapse on inspiration In severe cases this leads to dyspnœ
especially on exertion In other cases there is a liability to trachei
and laryngitis Rarely pressure on the recurrent nerve leads to paraly
of a vocal cord with dysphonia or hoarseness This feature is, howeve
more characteristic of carcinoma of the thyroid gland.

On examination the enlargement of the gland is usually obvio
In a doubtful case the nature of the swelling is indicated by the fa
that it moves with the trachea on deglutition owing to its fixation b
the pretracheal fascia.

For convenience three types of simple goitre are recognised. Th
should be regarded not as distinct entities, but as degrees or stages
a single process The earliest stage (*parenchymatous enlargement*)
a simple hypertrophy of the gland the second (*diffuse colloid goitr*
is a sequel to the first and represents an exaggerated involution phas
the third (nodular goitre) represents a continuation of the same proce
which in the course of time has influenced the gland in a patchy fashio
and led to the formation of nodular overgrowths

Parenchymatous Goitre (Adolescent Goitre) This condition occu
most often in girls at about the time of puberty It may be regard
as a simple hypertrophy of the gland an exaggeration of the norm
response to the demands of puberty



Fig 178. Adolescent goitre of un-
usually large size in a girl aged 1

The gland is diffusely enlarged and of soft consistency with micro-
scopically an increase in the number of acini present, but little othe
change. Clinically there is generally no evidence of any disturbanc
of the function of the gland or there may be slight nervousness o
other signs of mild hyperthyroidism.

The treatment is to administer iodine (5 minims of Lugol s iodin
daily), to eliminate any septic foci and to improve the general health.

Diffuse Colloid Goitre This is the condition assumed by a simple parenchymatous goitre that has persisted for more than a few months. It may be regarded as due to abnormal involution in a previously overtaxed gland

The thyroid gland is uniformly enlarged and of soft consistency Its cut surface has a peculiar translucent appearance and is honeycombed with minute glistening areas of colloid Microscopic examination shows the acini distended with well-stained colloid, while the epithelial cells for the greater part are somewhat flattened and show no evidence of their previous hyperplasia. Some of the acini distended and confluent, form small cysts.

The treatment of diffuse colloid goitre should be by operation to obviate the risk of further changes in the gland and also for cosmetic reasons The greater part of the gland is removed, leaving only an amount equalling the normal thyroid gland in size. Subsequently iodine should be administered for a few months.

Simple Nodular Goitre. This condition may be regarded as a sequel to a diffuse colloid goitre and a further result of abnormal involution in a previously overtaxed gland Consequently it is most common in older persons. It is termed " simple " to distinguish it from the toxic nodular goitre.

The nodules result from localised overgrowth or hypertrophy of groups of acini, which proliferate and enlarge, sometimes to a considerable size. There may be multiple nodules scattered through all parts of the gland, or a few only or even a single nodule, which may attain considerable size. The larger nodules often become cystic, owing to distension and confluence of acini The cysts may contain colloid material or watery fluid

Hæmorrhage may occur into such cysts, causing a sudden increase in size, accompanied by pain and sometimes leading to acute pressure upon the trachea. In later life the capsule of the cysts may become calcified and be so hard as to suggest the diagnosis of malignant disease.

Formerly the nodules were regarded as adenomata, and on naked-eye examination they resemble simple encapsulated tumours. It is now recognised, however that they are not true neoplasms, but localised areas of compensatory " hyperplasia resulting from abnormal involution. Microscopically they are composed of either small hyperplastic acini or more often, large acini distended by well-stained colloid.

Clinically the thyroid gland may be enlarged as a whole and present multiple smooth-surfaced nodules, some of which are readily palpable or even visible· or there may be one or more large, smooth, rounded swellings in an otherwise unaffected gland. The larger nodules may present the character of cysts.

The treatment of simple nodular goitre is by operation, in order to obviate the risk of toxic changes or malignancy and for cosmetic reasons. If there is a single large nodule or cyst it may be shelled out, but in most cases it is preferable to remove the whole gland except the

posterior parts of the lobes and isthmus. This portion is conserved to maintain the function of the thyroid and to prevent damage to the parathyroid glands.

TOXIC GOITRE (HYPERTHYROIDISM)

In toxic goitre the thyroid gland is overactive and thus leads to widespread and grave effects. It is not certain whether there is a simple excess of thyroxin (hyperthyroidism) or a modified form of hormone (dysthyroidism)

Two forms of toxic goitre are recognised primary toxic goitre (exophthalmic goitre Graves' disease) and secondary toxic goitre (toxic nodular goitre toxic adenomata) Although typically they are quite distinct, intermediate cases may be recognised with some of the features of each It is believed that the two types are not separate diseases, and that the differences depend upon the previous condition of the gland and on the age of the patient. Thus primary toxic goitre occurs generally in a young adult with a previously unaffected gland whereas secondary toxic goitre occurs in an older person with pre-existing simple enlargement of the gland.

Primary Toxic Goitre (Exopthalmic Goitre, Graves' Disease)

Primary toxic goitre occurs mainly in young adult women who have had no previous thyroid disease. Following upon some emotional stress or an infection such as tonsillitis or influenza, the thyroid gland becomes enlarged and a characteristic train of symptoms develops.

The gland is enlarged to a slight or moderate degree only The enlargement is uniform. The *gland is tense in consistence, and may* be so vascular as to transmit a thrill to the examining finger Microscopically the picture is one of intense activity The epithelial cells lining the acini are no longer cubical, but columnar and project into the acini as small tufts. The acini are small and contain but little colloid, which is poorly stained, for all the thyroxin being secreted is poured directly into the circulation and none is stored

Clinical Features. The symptoms and signs are due to increased metabolism and to over-excitability of the sympathetic nervous system.

The patient is nervous, easily excited and unduly irritable and suffers from insomnia. Owing to the accelerated metabolism she loses weight, though the appetite is voracious. As a result of instability of the vasomotor control she sweats easily and is liable to sudden flushing of the skin. She does not mind cold weather but dislikes the *heat of* summer

On examination, the skin is warm and moist. There is a fine tremor best seen when the hands are held out with the fingers wide apart. The pulse is persistently rapid. The systolic blood pressure is raised but the diastolic is unaffected, and consequently the pulse pressure (the difference between the two readings) is increased.

Lastly exophthalmos is present. It is believed to result from an increase in the tonus of plain muscle fibres within the orbit, which are supplied by the cervical sympathetic nerves. (Its converse enophthalmos, is seen when the cervical sympathetic chain is divided) Associated with the exophthalmos are widening of the palpebral fissure (Stellwag) defective power of convergence (Moebius) smoothness of the forehead when the patient looks up (Joffroy) and lagging of the upper eyelid when the patient looks down (v Graefe) The value of these signs has been exaggerated In severe cases closure of the eyelids is interfered with and ulceration of the cornea may develop

Primary toxic goitre is characteristically liable to remissions and relapses. In some cases complete recovery occurs spontaneously but more often there is a general tendency for succeeding relapses to be more and more severe. During the relapses all the signs and symptoms become more marked, and there may be wasting diarrhoea and evidence of heart failure. After repeated recurrences the disease tends to approximate in character to secondary toxic goitre.

Basal Metabolic Rate. The basal metabolic rate is valuable as an index of the degree of hyperthyroidism. In primary toxic goitre it is raised, perhaps to + 20 or even as high as + 50 The basal metabolic rate is estimated most correctly by the method of the Douglas bag or may be gauged approximately by the application of Read s formula —

$$\textit{Basal Metabolic Rate} = 0{\cdot}683\,(\textit{Pulse Rate} + 9/10\ \textit{Pulse Pressure}) - 71{\cdot}5$$

Treatment. The treatment may be by medical measures or by operation. Both methods have their disadvantages. Medical measures include rest in bed, sedatives such as pheno-barbitone, and the exhibition of thio-uracil. This drug is believed to combine with free iodine in the thyroid gland and thus to prevent the synthesis of thyroxin. It is given by the mouth in doses of 0·6 g daily and in most cases within a few weeks brings the metabolic rate down to normal The dose is then reduced to the maintenance level of 0 2 g daily which must be continued indefinitely

The disadvantages of thio-uracil treatment are that the gland often enlarges, hypertrophies and may become very vascular and that the dangerous state of agranulocytosis may develop at any time. As a check, a leucocyte count should be done at weekly intervals.

Surgical treatment is indicated in cases where thio-uracil administration has failed or cannot be carried out under proper surveillance. As an immediate preparation for operation, 10 minims of Lugol s iodine should be given thrice daily for fourteen days. This not only reduces the basal metabolic rate and all the symptoms of thyrotoxicosis, but also diminishes the vascularity of the gland and thus renders operation simpler and safer The effect of the iodine treatment quickly wanes after the fourteenth day so the date of operation should be fixed in advance and not postponed.

The operation consists in removing about seven-eighths of the gland, leaving the posterior parts of the lateral lobes to prevent damage to the

parathyroid glands With modern methods of preparation it carries very little risk, and recovery to normal health is rapid and complete. The earlier practice of operating in two stages is no longer necessary

Treatment with radio-active iodine is under trial, and may eventually displace other methods At present it is indicated principally in cases where operation is contra indicated, or where toxic manifestations have recurred after thyroidectomy It is contra indicated in pregnancy since the fœtal thyroid will be damaged by the isotope. Radio-active iodine is given as a single dose by mouth. The amount given is based on isotope tests of thyroid function (p 808) and the aim is to secure a gradual return to normal, both as regards the metabolic rate and the goitrous swelling, in the course of three or four months. If necessary a second dose may be given at that time or later If an overdose is given, myxœdema results, and requires treatment by continued medication with thyroid extract.

Secondary Toxic Goitre (Toxic Nodular Goitre, Toxic Adenomata)

Secondary toxic goitre occurs mainly in middle aged or elderly women who have previously suffered from simple enlargement of the thyroid gland though the enlargement may have been so slight as to be



FIG 179. Secondary toxic goitre in a woman aged 59 who had had a swelling in the neck for many years. She had recently suffered from excitability palpitations and tremulousness. There is slight exophthalmos, and the nervousness is evident.

barely noticeable. For the reasons discussed on an earlier page, the simple enlargement seen at later age periods is generally of the nodular type (simple nodular goitre) When toxic symptoms supervene, therefore, the term "toxic nodular goitre" may be used. The nodules were formerly regarded as adenomata, hence the old term "toxic adenomata.

Secondary toxic goitre differs from primary toxic goitre not only in

the character of the thyroid gland but also in the incidence of the various symptoms and signs.

The thyroid gland is considerably enlarged in most cases. Generally there are multiple nodules or "adenomata" scattered in all parts of the gland but sometimes there is a single nodule or cyst of considerable size. Occasionally the enlargement is entirely retrosternal and not obvious on first examination (see Intrathoracic Goitre, p 317) Microscopically there are hyperplastic changes similar to those in primary toxic goitre, but they are patchy in distribution and are interposed between dilated acini filled with colloid Generally the nodules are of simple colloid type and the hyperplastic changes mainly affect the intervening thyroid tissue

Clinical Features. The symptoms and signs are similar to those of primary toxic goitre, but differ in that the cardiac manifestations are more severe and the exophthalmos and nervous manifestations relatively slight.

The heart is gravely affected. There is myocarditis with persistent tachycardia, and auricular fibrillation is common There is marked loss of weight, sometimes amounting to emaciation.

Exophthalmos is relatively slight, and may be absent. There are, however exceptions to this rule, and pronounced exophthalmos is sometimes seen. Nervousness, sweating flushing of the skin and tremors may be present, but generally are not marked The basal metabolic rate is increased. A reading of + 40 is common

The course of secondary toxic goitre tends to be slowly progressive. There are no remissions, and the weakness of the heart gradually increases, eventually leading to congestive heart failure.

Treatment. Secondary thyrotoxicosis does not usually respond to thio-uracil medication and only temporarily to iodine and since the general tendency of the disease is to get worse, in most cases subtotal thyroidectomy should be advised

In bad risk cases radio-iodine treatment is indicated (p 314)

RARE TYPES OF GOITRE

Acute thyroiditis is rare. It may follow infection of the thyroid gland by organisms carried in the blood stream, and is then generally a complication of a severe acute disease, such as influenza or typhoid fever In other cases it occurs as a result of a local suppurative process, e.g cellulitis of the neck. It may arise in a normal gland or a goitrous one.

The inflammation may subside in a few days or go on to suppuration. The treatment is to apply fomentations and to open any abscess that forms.

Lymphadenoid Goitre (Hashimoto's Disease) is a disease of middle-aged persons, in which the thyroid gland undergoes rapid diffuse enlargement, with no thyrotoxic symptoms but often a tendency towards myxœdema, and in the late cases symptoms from pressure on

the trachea and oesophagus. On examination the gland is moderately enlarged, firm or even hard in consistency and somewhat fixed It is readily mistaken for a carcinoma. Microscopically there is almost complete disappearance of the acini, with lymphocytic infiltration and fibrous replacement.

Hashimoto s disease is now believed to be due to auto-immunisation It can be diagnosed on the basis of an immune reaction. No operation is required The treatment is to give thyroid extract.

Woody Thyroiditis (Riedel's Struma) is thought by some authorities to be a late sequel to Hashimoto's disease. It is a rare condition in which the gland becomes somewhat enlarged very hard and adherent both to the trachea and the muscles of the neck. Microscopically the main feature is fibrous tissue replacement of the gland acini. Clinically the condition resembles malignant disease and is usually diagnosed only on biopsy

TUMOURS OF THE THYROID GLAND

Adenoma

An adenoma forms a smooth rounded encapsulated tumour which may be situated either in the isthmus or in one of the lateral lobes. It may be solid or cystic. It may appear in childhood or early adult life, and an origin from cell nests has been suggested (fœtal adenoma) It tends to grow slowly and eventually causes pressure symptoms. A large adenoma may become pedunculated and gravitate into the superior mediastinum (retrosternal goitre) Hæmorrhage into a tumour or cyst causes sudden increase in size with pain and more acute pressure effects. In the course of time, the tumour may become calcified and be visible on radiography

Microscopic examination not infrequently shows features which may be interpreted as early malignant change (carcinoma *in situ*) For this reason operative removal is the standard treatment. The prognosis in such cases is entirely favourable. Real malignant change, with the development of a carcinoma which invades adjacent tissues and metastasizes, is extremely rare.

The adenoma may be shelled out from within its capsule, after the gland has been exposed by the same technique as for thyroidectomy

Multiple adenomata occur mainly in elderly persons and usually they give a history of simple enlargement of the thyroid gland which has been present for a number of years. The adenomata are regarded not as tumours but as areas of nodular hyperplasia related to simple goitre. The treatment is by subtotal thyroidectomy (p 318)

Carcinoma

Carcinoma of the thyroid gland is by no means rare, and is said to be found in over 1 per cent. of all goitres It occurs most often in middle-aged or elderly patients. Microscopically it may take the form of a malignant adenoma, a papilliferous adenocarcinoma or an undifferentiated carcinoma.

Clinically we may recognise three types The commonest type is characterised by its slow but relentless growth and its tendency to local invasion and local lymph node involvement. The growth forms a hard mass which progresses slowly over many months or several years. It invades adjacent tissues and becomes fixed to the muscles and soft tissues of the neck. It may involve the recurrent nerves, leading to hoarseness Eventually it metastasises to lymph glands in the neck This type must be diagnosed from syphilitic (gummatous) infiltration and from Hashimoto's disease. If at all practicable the treatment is to remove the mass, even though this involves complete removal of the thyroid gland and may involve removal of the parathyroids and division of the recurrent nerves. Radiotherapy is not effective.

The second type, which consists mainly of those with the microscopic features of anaplastic cancer is characterised by rapid spread and early metastasis to distant sites, including lymph nodes, the lungs and the bones (especially the skull sternum, spine and humerus) Occasionally a metastasis calls attention to the disease while the primary growth is still too small to attract notice. In this type radiotherapy sometimes gives a striking though invariably a temporary response.

The third type is the so-called carcinoma *in situ*. This term is given to those cases in which microscopic examination of a portion of the gland, usually an adenoma (removed supposedly as a benign lesion) shows small groups of cells whose appearance suggests malignancy Similar appearances have been noted in the breast, the prostate and the lungs. It is doubtful if they can be regarded as true malignancy and the prognosis is uniformly favourable.

It should be added that there are occasional cases of cancer of the thyroid gland in which the malignant cells retain the avidity for iodine of the normal thyroid gland. In such cases if a tracer dose of radioactive iodine is administered, a counter placed over the tumour or its metastases will show a rapid take-up of the iodine This property may be utilised therapeutically A large dose of the isotope is given in the hope that enough will concentrate in the tumour to irradiate and destroy the tumour cells. Such cases are, however very few and the results in general are disappointing

RETROSTERNAL (INTRATHORACIC) GOITRE

Any large simple goitre may extend downwards behind the infrahyoid muscles, so that its lower part lies below the thoracic inlet, but the term " retrosternal " or " intrathoracic goitre is generally reserved for those cases in which little or no swelling is apparent in the neck. Almost always the condition is due to downward displacement of a colloid adenoma or colloid cyst originating from the lower pole of one of the thyroid lobes.

The intrathoracic mass occupies the superior mediastinum immediately behind the manubrium sterni, and with increasing size may exert pressure effects upon adjoining structures, especially the

trachea, the recurrent nerves and the innominate veins. In some cases the mass lies wholly and *permanently in the thorax* in others it can be forced up into the neck by a powerful expiratory effort (plunging goitre) There is generally no evidence of any alteration in the function of the thyroid, but occasionally there are symptoms of toxicity

Clinical Features. While the *intrathoracic mass remains small* there may be no symptoms. The first signs may result from pressure. Pressure on the trachea may cause cough, dyspnœa, and perhaps an inspiratory stridor Pressure on a recurrent nerve will lead to hoarseness. Pressure on the innominate veins may lead to venous congestion of the head and neck, and even to a tinge of cyanosis.

Radiographic examination shows an area of density in or close to the midline and demonstrates the trachea, which is generally displaced to one side and may be compressed.

Treatment. The treatment is to remove the intrathoracic mass in all cases where the general condition of the patient permits The operation is carried out through the usual collar incision in the lower part of the neck. The normally placed part of the gland is first exposed and its connection with the intrathoracic mass is displayed. If the correct plane of cleavage is now found, it is generally quite easy to mobilise the intrathoracic mass by blunt dissection, and to bring it up into the neck. It has no vascular connections within the thorax, so there should be no bleeding

THE PARATHYROID GLANDS

The function of the parathyroid glands is to secrete *parathormone* a hormone which exercises an important controlling influence upon the metabolism of calcium and phosphorus, and thus indirectly upon calcification and ossification and upon the excitability of nerves and muscles.

Excessive secretion (hyperparathyroidism) is produced by a para thyroid adenoma. Impaired secretion (hypoparathyroidism) is seen most acutely ofter removal of a secreting adenoma and is an occasional mischance after operations for goitre.

Parathyroid Adenoma

This is a benign tumour of one of the parathyroid glands, usually of small size, a centimetre or so in diameter and of soft consistency It causes no local pressure effects, is rarely palpable in the neck, and owes its symptoms entirely to the fact that it produces parathormone, which when in excess causes calcium to be liberated from the skeleton, and thus leads to the development of osteitis fibrosa (p 105) The calcium liberated mounts up in the blood stream, and the blood calcium is raised from the normal figure of 10 mg per cent. to 12 or more. The excess of calcium is then excreted by the kidneys and bowel In some cases the excess is so great that stones form in the urinary tract.

The clinical features are discussed on p 105 The diagnosis depends on the serum calcium level. If the total calcium is normal separate estimation of the ionised calcium may show a marked rise Increase in the urinary calcium is less dependable.

The treatment is to remove the affected gland A collar incision is made in the neck and the whole thyroid gland is widely exposed The adenoma may be in front of or behind or to one side of the thyroid gland and it may be close to it or far distant, but once found it is readily recognised by its bright yellow colour Sometimes a thyroid adenoma or even an isolated lobule of normal thyroid gland has been removed in error but this should not happen, as the parathyroid adenoma is quite distinctive. If, therefore, a wide search of the neck fails to reveal it, the surgeon should proceed either at once or at a later session, to explore the superior mediastinum. The incision is extended downwards in the midline, the sternum is split with a chisel downwards and fractured outwards at the level of the third interspace. The two parts can then be retracted laterally and the whole superior mediastinum laid to view If the adenoma is found in this situation it can be dissected out with ease.

After the adenoma has been removed there is a great tendency to an acute parathyroid deficiency until the other glands which have been in abeyance resume their function. The symptoms and treatment of this condition are discussed below

Parathyroid Tetany

This is a form of tetany due to impairment of the parathyroid secretion. It develops occasionally after the operation of thyroidectomy and much more regularly after removal of a parathyroid adenoma.

The symptoms of hypoparathyroidism which result are due to lowering of the calcium content of the blood, which is reduced from the normal of 10 mg per cent. to 8 or even 6 mg per cent. The symptoms may appear within a few hours of the operation, or only after a few days. They are characterised by increased excitability of nerves and muscles At first there is a sensation of numbness or tingling in the extremities, and later cramp-like contractures develop in the fingers, hands and feet (carpo-pedal spasms)

The increased excitability may be demonstrated by two signs. *Chvostek's sign* consists in tonic contraction of the facial muscles when percussion is carried out over the facial nerve. *Trousseau's sign* consists in spasm of the flexor muscles of the forearm and hand when compression is applied to the arm.

In severe cases laryngospasm may occur causing dyspnoea and even asphyxia.

Post-operative hypoparathyroidism is usually temporary passing off in the course of a week or two In osteitis fibrosa, however when the parathyroid tumour is removed the "hungry bones" abstract calcium from the blood stream and maintain the state of tetany even for months.

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Clinical Features. While the intrathoracic mass remains small there may be no symptoms. The first signs may result from pressure. Pressure on the trachea may cause cough, dyspnœa, and perhaps an inspiratory stridor Pressure on a recurrent nerve will lead to hoarseness. Pressure on the innominate veins may lead to venous congestion of the head and neck, and even to a tinge of cyanosis

Radiographic examination shows an area of density in or close to the midline and demonstrates the trachea, which is generally displaced to one side and may be compressed

Treatment. The treatment is to remove the intrathoracic mass in all cases where the general condition of the patient permits. The operation is carried out through the usual collar incision in the lower part of the neck. The normally placed part of the gland is first exposed and its connection with the intrathoracic mass is displayed. If the correct plane of cleavage is now found it is generally quite easy to mobilise the intrathoracic mass by blunt dissection, and to bring it up into the neck. It has no vascular connections within the thorax, so there should be no bleeding

THE PARATHYROID GLANDS

The function of the parathyroid glands is to secrete *parathormone* a hormone which exercises an important controlling influence upon the metabolism of calcium and phosphorus, and thus indirectly upon calcification and ossification and upon the excitability of nerves and muscles.

Excessive secretion (hyperparathyroidism) is produced by a para thyroid adenoma. Impaired secretion (hypoparathyroidism) is seen most acutely after removal of a secreting adenoma and is an occasional mischance after operations for goitre.

Parathyroid Adenoma

This is a benign tumour of one of the parathyroid glands, usually of small size a centimetre or so in diameter and of soft consistency It causes no local pressure effects, is rarely palpable in the neck, and owes its symptoms entirely to the fact that it produces parathormone, which when in excess causes calcium to be liberated from the skeleton, and thus leads to the development of osteitis fibrosa (p 105) The calcium liberated mounts up in the blood stream, and the blood calcium is raised from the normal figure of 10 mg per cent. to 12 or more. The excess of calcium is then excreted by the kidneys and bowel In some cases the excess is so great that stones form in the urinary tract.

The clinical features are discussed on p 105 The diagnosis depends on the serum calcium level. If the total calcium is normal separate estimation of the ionised calcium may show a marked rise Increase in the urinary calcium is less dependable

The treatment is to remove the affected gland. A collar incision is made in the neck and the whole thyroid gland is widely exposed The adenoma may be in front of or behind or to one side of the thyroid gland and it may be close to it or far distant, but once found it is readily recognised by its bright yellow colour Sometimes a thyroid adenoma or even an isolated lobule of normal thyroid gland has been removed in error but this should not happen, as the parathyroid adenoma is quite distinctive. If, therefore, a wide search of the neck fails to reveal it the surgeon should proceed either at once or at a later session to explore the superior mediastinum. The incision is extended downwards in the midline, the sternum is split with a chisel downwards and fractured outwards at the level of the third interspace. The two parts can then be retracted laterally and the whole superior mediastinum laid to view If the adenoma is found in this situation it can be dissected out with ease.

After the adenoma has been removed there is a great tendency to an acute parathyroid deficiency until the other glands which have been in abeyance resume their function. The symptoms and treatment of this condition are discussed below

Parathyroid Tetany

This is a form of tetany due to impairment of the parathyroid secretion. It develops occasionally after the operation of thyroidectomy and much more regularly after removal of a parathyroid adenoma.

The symptoms of hypoparathyroidism which result are due to lowering of the calcium content of the blood, which is reduced from the normal of 10 mg per cent. to 8 or even 6 mg per cent. The symptoms may appear within a few hours of the operation, or only after a few days. They are characterised by increased excitability of nerves and muscles At first there is a sensation of numbness or tingling in the extremities, and later cramp-like contractures develop in the fingers, hands and feet (carpo-pedal spasms)

The increased excitability may be demonstrated by two signs *Chvostek's sign* consists in tonic contraction of the facial muscles when percussion is carried out over the facial nerve. *Trousseau's sign* consists in spasm of the flexor muscles of the forearm and hand when compression is applied to the arm.

In severe cases laryngospasm may occur causing dyspnoea and even asphyxia.

Post-operative hypoparathyroidism is usually temporary passing off in the course of a week or two In osteitis fibrosa, however when the parathyroid tumour is removed the "hungry bones abstract calcium from the blood stream and maintain the state of tetany even for months.

Treatment. Control of the tetany is effected *instantaneously* by intravenous injection of calcium gluconate (10 to 20 ml. of 20 per cent. solution twice or thrice daily) Parathormone (80 to 200 units daily) is sometimes effective but it may lose its effect after a week or two. Calcium lactate is given by mouth (80 grains t.d.s.) In persistent cases large doses of calciferol (800 000 units daily) give marked benefit. Care must be taken not to give blood transfusion for the citrate by combining with calcium reduces the ionised calcium and will aggravate the tetany

THE THYMUS GLAND

The thymus increases in size slightly during childhood, but after puberty it atrophies progressively so that in adults it is almost entirely replaced by fat.

In *myasthenia gravis* the thymus may be hypertrophied or a simple tumour may be present. In such cases the thymus may be removed, access being gained by splitting the upper half of the sternum.

Hypertrophy of the thymus also occurs in children and may then give rise to symptoms through pressure on neighbouring structures particularly acute dyspnoea with cyanosis and an inspiratory stridor (thymic asthma)

Tumours of the Thymus. Simple tumours are rare. They have sometimes been found in association with myasthenia gravis

Malignant tumours are not uncommon The "malignant thymoma" was formerly regarded as a lymphosarcoma of the mediastinum which it closely resembles It invades neighbouring structures and causes pressure effects similar to mediastinal tumours Carcinoma of the thymus also occurs and has similar effects The treatment is by X-ray or radium therapy

Status Lymphaticus. This is a condition sometimes found in children who have died from no obvious cause, especially during anaesthesia. The thymus is enlarged and there is a diffuse hypertrophy of all the lymphatic tissues in the body In addition the patient is generally of fat and flabby habit, the heart muscle is thin and the arteries are of small calibre. In the past death was sometimes attributed to the pressure of the enlarged thymus upon the mediastinal vessels and nerves. It is now thought, however that a sudden vasomotor paralysis is responsible.

CHAPTER 28

THE LARYNX, PHARYNX AND ŒSOPHAGUS

DYSPHONIA AND APHONIA

Apart from transitory hoarseness due to catarrhal laryngitis or irritation by fumes or excessive smoking, dysphonia and aphonia may be due to the following causes —

(1) Affections of the vocal cords—tuberculosis, syphilis, tumours.

(2) Carcinoma of the hypopharynx (post-cricoid cancer)

(3) Diseases affecting the innervation of the larynx whether in the central nervous system or at the level of the recurrent nerve (new growths, toxic neuritis, aortic aneurysm, etc.)

(4) Rarely hysterical paralysis.

The diagnosis depends upon a full clinical examination followed by laryngoscopy and supplemented if necessary by such measures as sputum examination, Wassermann reaction and radiographic investigation.

DYSPHAGIA

Apart from transitory difficulty in swallowing associated with painful affections such as mumps, pharyngitis and laryngitis, dysphagia may be due to the following causes —

(1) Foreign body in the gullet.

(2) Intrinsic diseases of the gullet such as pharyngeal pouch, peptic ulcer carcinoma, fibrous stricture, cardiospasm Carcinoma arising at the cardiac end of the stomach may have the same effect.

(3) Extrinsic pressure, e.g by tumour goitre, aortic aneurysm.

A full history and clinical examination should be followed as a routine by radiography and a barium swallow In some cases œsophagoscopy is required.

FOREIGN BODIES

Foreign Body in the Larynx. Such foreign bodies as a button, coin or small denture may be aspirated into the larynx during a sudden inspiratory effort—for example, in laughing or sneezing If the larynx is completely blocked, a rapidly fatal asphyxia ensues if the obstruction is incomplete, when, for example, a small object lodges in the ventricle, there is acute dyspnœa, with spasmodic cough and recurring fits of choking which threaten suffocation.

The treatment in an emergency is to perform laryngotomy This is simply done by opening the crico-thyroid membrane through a *short* transverse incision immediately above the cricoid cartilage, and in an

acute emergency the operation may be performed with a razor or even a sharp penknife.

If the symptoms are less urgent, the throat should be sprayed with cocaine and examined with a laryngeal mirror or by direct laryngoscopy If the foreign body can be seen it can generally be extracted without much difficulty Rarely if the body is impacted, it is necessary to open the larynx by median laryngofissure.

Foreign Body in the Bronchus. Such foreign bodies as buttons, small metallic objects, teeth, nuts and peas may be aspirated into the bronchi They generally lodge in the lowest branch of the right bronchus, owing to its vertical position.

At the time of aspiration there is generally a sharp fit of coughing or choking but this passes off soon and may not attract special attention, particularly if as often happens, the body is aspirated during sleep or intoxication. Since the bronchus is obstructed the affected lobe of the lung undergoes collapse, and pneumonia develops. It may even go on to lung abscess and empyema.

The diagnosis is not always easy In a suspected case radiography is indicated, and if the body is non-opaque a further examination should be made after injecting lipiodol into the bronchial tree.

The treatment is to remove the body by means of a bronchoscope. Preferably the extraction should be performed within twenty four hours of the accident, for œdematous swelling of the bronchial mucosa rapidly hides the body and renders its removal difficult.

Foreign Body in the Pharynx. If taken intentionally quite large foreign bodies may be swallowed successfully a small object taken unintentionally on the other hand, is very apt to be held up especially if sharp-edged. Thus the common foreign bodies in the pharynx are coins, fish bones and dentures In intoxicated or semi-conscious persons, however any solid object—for example, a bolus of unmasticated food—may be arrested. Such an object, if impacted opposite the glottis, may cause rapidly fatal asphyxia, or even sudden death from syncope without the usual signs of suffocation.

A small body impacted in the pharynx gives rise to pain and an acute sense of choking which continues even after the body has been removed, owing to reflex spasm If the object is sharp-pointed, e.g a fish bone, it may perforate the mucous membrane and lead to cellulitis of the neck or mediastinum.

The treatment in an emergency is to gag the mouth open and hook the object out with a finger If this fails, and the respiratory obstruction is acute, laryngotomy may prove necessary In less urgent cases the throat should be sprayed with cocaine and examined with a pharyngoscope. Generally the foreign body can be removed through the pharyngoscope. If this fails, it is necessary to explore the pharynx through an incision in the side of the neck, with due precautions to prevent infection of the cellular planes.

Foreign Bodies in the Œsophagus. The considerations governing impaction of foreign bodies in the pharynx apply also to the œsophagus.

The usual foreign bodies in this situation are coins, safety pins and dentures. They may be arrested at the level of the manubrium sterni at the crossing of the left bronchus, or near the lower end of the œsophagus.

At the time of impaction there is a sudden pain in the thorax, and usually there is an acute choking attack. There is considerable dysphagia and sometimes dyspnœa. These acute symptoms tend to settle, however but some pain on swallowing nearly always persists. If the object is smooth and rounded it may pass through into the stomach, once the local spasm of the œsophagus is relieved More often, especially if the object is sharp-pointed, it remains firmly impacted and causes considerable damage to the wall of the œsophagus, or may even perforate the wall and project into the mediastinum. In these circumstances there is a grave risk of mediastinitis.

The diagnosis of foreign body in the œsophagus is not always easy In some cases the history is unreliable, especially in children, who are often unjustly suspected of having swallowed a missing coin or toy In adults hysterical spasm of the œsophagus may cause difficulty or the patient may imagine that some object accidentally swallowed has lodged in the gullet. For these reasons radiography is advisable. If the suspected foreign body is non-opaque to X rays, a thin emulsion of barium may outline it. If doubt still remains, œsophagoscopy may also be required

The treatment is to remove the foreign body by means of special instruments introduced through an œsophagoscope. Many special instruments have been invented for removing foreign bodies, and there are many special points of technique, especially for sharp-pointed objects, such as open safety pins, which may be partly embedded in the mucosa. When possible, extraction of the body should be performed without delay for if it remains impacted it becomes hidden by œdematous mucosa, and moreover the risk of infection is increased Such, however are the risks of unskilled attempts at extraction that every effort must be made to obtain the services of a skilled endoscopist.

The old fashioned probangs, coin-catchers and other blind instruments are dangerous and should not be used If all other methods fail, it is sometimes necessary to operate. The upper end of the œsophagus may be reached in the root of the neck, the lower end by means of an opening into the stomach or through the left pleura.

ŒDEMA OF THE GLOTTIS

Œdema of the glottis is most often inflammatory in origin, as a result of acute infections of the pharynx or neck, or may occur as a complication of lesions of the larynx, such as tuberculosis, syphilis or carcinoma. Less often the œdema is non inflammatory and arises from cardiac or renal disease or allergy

The disease is characterised by swelling of the lax tissues in relation to the epiglottis, ary-epiglottic folds and false cords. If severe, it

obstructs the airway and causes dyspnœa, which may progress to suffocation.

The treatment in a mild case is to place the patient in a steam tent and to spray the larynx with cocaine and adrenalin. In a severe case, with impending suffocation, the larynx should be intubated or laryngotomy performed

PHARYNGEAL POUCH

This rare affection is a pulsion diverticulum or hernia composed of the mucous and submucous coats of the pharynx, forced by the intra pharyngeal pressure through a weak point in the muscular tunic.



FIG. 180. Pharyngeal pouch from a man aged 65 who suffered from dysphagia and regurgitation of food after meals. The barium outlines the dilated lower part of the pharynx and fills the pouch, the orifice of which is indicated by the arrow A trickle of barium is seen passing down the œsophagus, displaced to the side of the pouch.

The herniation occurs in the midline of the posterior wall of the pharynx near its lower end, between the transverse and oblique fibres of the inferior constrictor The pouch assumes a pyriform shape and, sagging with the weight of its contents, may even reach the mediastinum. It pulls upon the pharynx so that the orifice of the sac lies in a direct line with the pharynx, while the œsophagus is displaced to one side.

A pharyngeal pouch arises most often in middle-aged or elderly men. It causes gradually increasing difficulty in swallowing, and in severe cases may even lead to loss of weight from starvation Often the patient is aware of a gurgling or splashing sound occurring in the neck during meals Later food is regurgitated immediately after or even during meals, and regurgitation may be effected by pressing on the pouch.

The diagnosis is to be made by radiography after administration of barium. The barium can be seen under the screen as it pours directly into the sac and then overflows into the displaced œsophagus.

The treatment is to expose the sac, after gaining access between the thyroid gland and the carotid sheath on the left side, and to remove it. The older two-stage operation, designed to reduce the risk of infection is now no longer necessary

TUMOURS OF THE LARYNX AND PHARYNX

Papilloma of the Vocal Cord. This simple tumour occurs at any age and is not uncommon in childhood It forms a pale, villous growth on either the true or the false vocal cords In adults the tumour is generally small and of warty appearance, and is to be distinguished from an early carcinoma. In children it is of softer character and may attain large size and may thus obstruct the airway

The main clinical feature is hoarseness. If the tumour is large it may cause shortness of breath, stridor and attacks of acute dyspnœa.

The treatment is to remove the growth by means of special forceps introduced through a laryngoscope.

Carcinoma of the Vocal Cord (Intrinsic Carcinoma of the Larynx) This is a squamous epithelioma which grows slowly and only metastasises at a late stage. It originates on the true vocal cord generally near its anterior end, and forms a small warty growth, which spreads gradually over the cord and may later involve the adjacent tissues, but remains limited to the larynx for as long as one or even two years.

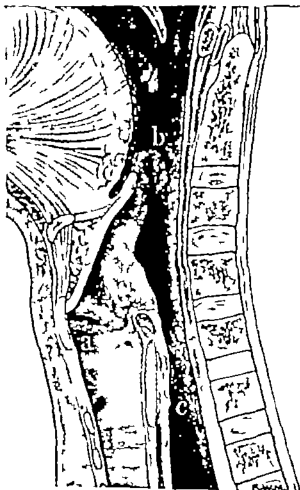


FIG. 181 Tumours of larynx and pharynx.
(a) Carcinoma of vocal cord (intrinsic carcinoma of larynx).
(b) Epilaryngeal carcinoma (extrinsic carcinoma of larynx) arising from epiglottis.
(c) Post-cricoid carcinoma of hypopharynx.

The tumour occurs generally in men over fifty years of age, and its cardinal symptom is hoarseness, gradually progressing to aphonia.

Laryngoscopy which should always be carried out in adults with hoarseness of more than three weeks' duration reveals the growth and also shows some restriction of the movement of the affected cord.

The treatment may be by radium or operative resection Radium is to be preferred generally The larynx is first exposed from the neck and a window removed from one ala of the thyroid cartilage, sufficient to accommodate a number of radium needles, which are placed in position without injuring the mucous membrane. Alternatively an early tumour may be removed by the operation of median thyrotomy (laryngofissure) gaining access by splitting the thyroid cartilage in the midline. For a more extensive growth it may be necessary to remove half or even the whole larynx.

The prognosis in cases treated promptly and efficiently is excellent.

Epilaryngeal Carcinoma (Extrinsic Carcinoma of the Larynx). This is a squamous epithelioma which arises from the epiglottis, the aryepiglottic folds, or the pyriform recess. It forms a raised indurated ulcer which spreads widely and soon involves the regional lymph glands in the neck. These features and the absence of symptoms in the early stages, render the prognosis grave.

The growth arises almost always in men over fifty years of age. The first symptom may be a tickling sensation in the throat, or the feeling of a foreign body lodged there. Then dyspnœa and dysphagia develop, with especial difficulty in disposing of saliva, and there may be a bloodstained mucopurulent discharge. The voice may be affected and assume a peculiarly thick character In some cases, especially in a growth of the pyriform sinus, the presence of hard glands in the neck may first call attention to the growth. In the late stages there is severe pain in the neck and referred to the ears Death usually results from inhalation pneumonia.

Laryngoscopy reveals the indurated, raised ulcer surrounded by œdematous mucous membrane.

All forms of treatment are unsatisfactory Radical excision is possible only at an early stage and carries a high mortality even in expert hands. As a rule, better results, albeit palliative, are obtained with radium beam therapy or deep X rays. If the dysphagia and dyspnœa progress, gastrostomy and tracheotomy may be required.

Post-cricoid Carcinoma (Carcinoma of the Hypopharynx) This is a squamous epithelioma which, unlike other growths in this region, occurs mainly in young women averaging forty years of age. Often there is a previous history of spasmodic dysphagia.

There is an ulcerating growth, which spreads up and down the pharynx in the post-cricoid region, and also encircles the gullet, forming a stricture. It metastasises to the glands of the neck at an early stage, and may involve the recurrent laryngeal nerve or invade the thyroid gland

The symptoms are insidious in onset, and often the main feature is

an exaggeration of a long standing spasmodic dysphagia. In some cases the onset is more rapid, with an acute attack of dysphagia, which may be attributed to a foreign body causing sudden spasm at the site of the tumour. A single attack of this sort in a thin, anaemic young woman with a long history of slight dysphagia should suggest the diagnosis. Later the dysphagia becomes persistent, food and saliva are regurgitated and actual starvation may result. In the later stages cough, aphonia, dyspnœa and severe pain develop.

The tumour is not palpable in the neck, but the larynx may be noticeably displaced forwards, and the thyroid gland may be involved, or there may be enlarged lymph glands. On laryngoscopy the growth is not visible, but it may be suspected by the presence of a pool of saliva and exudate in the hypopharynx, or œdema and fixity of the tissues in the arytenoid region.

The treatment of an early case may be by radial excision, a mutilating operation of considerable severity, or by exposure to radium or deep X ray therapy. The prognosis is poor. In the late stages gastrostomy or tracheotomy may be required.

CARCINOMA OF THE ŒSOPHAGUS

Carcinoma of the œsophagus is found most often near the lower end of the gullet, at the level of or just above the diaphragm. Less often it arises at the level of the left bronchus or in other parts of the tube.

The growth is a squamous epithelioma, which ulcerates, encircles the lumen and forms a stricture, invades neighbouring structures and spreads to para aortic lymph glands and to the liver. A gland at the root of the left side of the neck may be involved.

The clinical features are generally characteristic. Unlike the post-cricoid carcinoma, which it resembles closely in other respects, the growth occurs mainly in elderly persons, especially men. The cardinal symptom is dysphagia, which progresses steadily though with slight intermissions in the early stages, and ultimately leads to death from starvation and



FIG. 182. Carcinoma of the œsophagus. Barium fills the somewhat dilated œsophagus and outlines the malignant stricture.

cachexia. At first the difficulty in swallowing is experienced with solid foods, later with semi solids and fluids

The diagnosis is to be made from fibrous stricture of the œsophagus, cardiospasm, and from a carcinoma at the fundus of the stomach. A barium swallow demonstrates the presence of an irregular stricture with slight dilatation of the œsophagus above œsophagoscopy should be carried out to confirm the diagnosis, and a small fragment of the growth removed for microscopic examination

The treatment is still unsatisfactory In an early growth near the lower end radical resection should be attempted. Access is gained through either the left or the right pleural cavity the mediastinal pleura is divided and the œsophagus dissected free. The œsophagus is divided a full inch above the growth and removed, with, if necessary the upper part of the stomach. Continuity may be restored by anastomosing the œsophagus to the lower part of the stomach after it has been mobilised and brought up into the thorax. Alternatively the œsophagus may be joined to jejunum after an Roux en Y anastomosis. The immediate risk attached to this type of operation is considerable and the ultimate results remain poor Occasionally if the growth cannot be removed it is possible to perform a palliative anastomosis between the dilated œsophagus above the growth and a Roux loop of jejunum

If such methods are not thought feasible, a considerable degree of palliation can be obtained by deep X ray treatment, or by the use of a radium bougie inserted for short periods to lie within the malignant stricture. Other palliative methods such as gastrostomy are now practised rarely

CORROSIVE STRICTURE OF THE ŒSOPHAGUS

Fibrous stricture of the œsophagus follows ulceration of the mucous membrane by corrosive poisons swallowed accidentally or with suicidal intent. The ulceration is often extensive, and the resulting stricture may be 2 or 3 inches in length. The stenosis develops rapidly and eventually the lumen may be almost completely occluded.

The treatment in an early case is to dilate the stricture by bougies, and to keep the channel patent by regular dilatation at intervals of a few weeks. The bougie should preferably be introduced under direct vision through an œsophagoscope. If this fails recourse must be had to gastrostomy Rarely if there is a sufficient length of healthy gullet above the stricture, it may be anastomosed, end to-side, to a Roux loop of jejunum Operative removal of the stricture is almost always impracticable owing to dense mediastinal adhesions

CARDIOSPASM ACHALASIA OF THE ŒSOPHAGUS

This affection is characterised by great dilatation of the œsophagus, due to a long-standing functional obstruction at its lower end.

It is believed that the primary cause is a defect of neuro-muscular co-ordination at this point. This may be due to faulty innervation as is indicated by paucity of ganglion cells in the intermuscular plexus. As a result the lower end of the œsophagus fails to relax during deglutition,

and a functional obstruction develops. The remainder of the œsophagus becomes hypertrophied to overcome the obstruction and then dilates. Eventually the dilatation is extreme. Food, mucus and saliva stagnate in the dilated tube and there ferment; infection spreads to the wall, and the mucous membrane may be extensively ulcerated.



Fig. 183. Lesions of Œsophagus. (a) Carcinoma of lower third of œsophagus, (b) cardiospasm, (c) hiatus hernia with peptic œsophagitis.

The disease may start in early life, but the onset of symptoms may be delayed several years. Often the first symptom is a sudden attack of dysphagia, which is severe, with difficulty in swallowing both solids and fluids. After this acute onset the progress is variable, and generally



Fig. 184. Cardiospasm. The œsophagus, filled with barium, is greatly dilated in a cylindrical fashion. Its lower end presents a characteristic tapering "rat tail" shape.

there are remissions of long duration In the later stages there is much loss of weight from starvation

The diagnosis is confirmed by a barium swallow The œsophagus is seen to be greatly dilated, but of smooth contour throughout, and terminating below in a smooth conical or tapering extremity at the *diaphragmatic hiatus.*

In treatment, the method formerly in vogue of dilatation by a mercury bougie is no longer favoured. Two surgical methods are now practised and either can be relied upon to give complete relief in the majority of cases. The one method is to dilate the narrow part by means of a hydrostatic bag or other special dilators. This method should be used only by an expert endoscopist, for forcible dilatation carries the risk of tearing the mucosa and causing mediastinitis.

The better method is by Heller s operation. This simple procedure is readily carried out through a short epigastric incision though some surgeons prefer the thoracic route. The terminal part of the œsophagus *is exposed together with the cardia and proximal stomach. A longi* tudinal incision is made through the muscle coats and down to but not through the mucous membrane, which is seen to bulge freely through the gap in the outer coats. No further treatment is necessary

REFLUX ŒSOPHAGITIS (Peptic Ulcer of the Œsophagus)

This lesion is due to erosion of the squamous cell membrane of the œsophagus by gastric juice. It is not a deep crater like a gastric ulcer but a superficial erosion like the skin digestion round a gastrostomy It occurs when there is frequently repeated reflux of gastric juice and this is common as a complication of hiatus hernia (p 878) especially when this condition is associated with shortening of the œsophagus.

X ray examination after a barium swallow shows a localised sharp constriction near the lower end of the gullet, often partly due to spasm and therefore varying from time to time. Diaphragmatic hernia and a pouch of stomach in the thorax may be shown after the barium is swallowed by tilting the patient head-down. The diagnosis is confirmed *by œsophagoscopy*

Various stages in this process may be recognised. In many cases a hiatus hernia is present with little or no reflex. Symptoms are then absent and no treatment is called for In the next stage the œsophagitis is not severe and postural heartburn is the main feature. The heartburn is precipitated by occupations involving stooping and straining, such as scrubbing the floor and gardening and it often occurs at night in bed. Alkalies should be given, or antacid tablets to be sucked con tinuously and the patient should sleep propped up

In the next stage the œsophagitis is severe, with dysphagia, marked pain on swallowing and repeated oozing of blood leading to severe anæmia. At this stage operation is indicated. Access is gained through the left pleural cavity the stomach and œsophagus are freed and the



FIG. 185. Hiatus hernia. The niche of a peptic ulcer of the œsophagus is seen just above the small intrathoracic pouch of stomach.



FIG. 186. Peptic ulcer of œsophagus. The dilated œsophagus terminates in a smooth conical stricture. A large pouch of stomach lies in the thorax.

hernia reduced the diaphragmatic hiatus is defined and reduced to its normal size by non absorbable sutures. Since the vagus nerves will have been divided a pyloroplasty or gastro-jejunostomy is performed to prevent gastric retention.

In late cases a stricture forms, leading to progressively severe dysphagia and regurgitation and in consequence to malnutrition and loss of weight. In these latter stages bougienage may be tried, but often it is necessary to resect the stricture, restoring continuity by joining the œsophagus to a Roux end of jejunum.

VARICES OF ŒSOPHAGUS

Varicose veins in the lower part of the œsophagus are an important cause of severe hæmatemesis. They arise in association with portal hypertension due to hepatitis, and are usually accompanied by splenomegaly They are discussed on p 442.

CHAPTER 29

THE BREAST

Clinical Examination

Inspection. The patient should be seated and both breasts, fully exposed, should be inspected, first from the front, and then in profile from above.

Attention is first directed to the nipples, which should be on the same level and similar in appearance. Elevation or retraction of one nipple may be an early sign of carcinoma (A similar appearance may result from a former mastitis or from congenital retraction and such possibilities should be ruled out by the history)

The general contour is then observed, and any swelling noted Lastly, the skin of the breast is inspected more closely for evidence of dimpling which may result from the pull of an underlying carcinoma, and for "*peau d'orange*" thickening, due to malignant infiltration.

Palpation. The surgeon should stand behind the seated patient and palpate the right breast with the left hand, the left breast with the

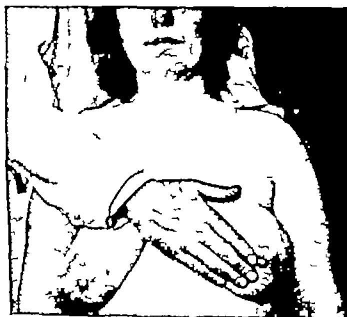


FIG. 187 Method of palpating the breast.

right hand (Fig 187) The examination should be conducted on a definite plan, each part of the breast being palpated first between fingers and thumb, and then with the flat of the hand against the chest wall. In all cases the two breasts should be compared in every particular

The nipple is palpated first, any induration observed and the character of any expressed secretion noted

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The general contour is then observed, and any swelling noted Lastly the skin of the breast is inspected more closely for evidence of dimpling which may result from the pull of an underlying carcinoma, and for "*peau d'orange*" thickening due to malignant infiltration.

Palpation. The surgeon should stand behind the seated patient and palpate the right breast with the left hand the left breast with the

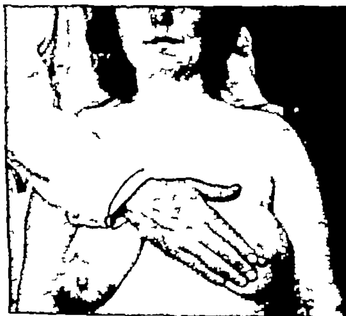


FIG. 187 Method of palpating the breast.

right hand (Fig 187) The examination should be conducted on a definite plan, each part of the breast being palpated first between fingers and thumb and then with the flat of the hand against the chest wall. In all cases the two breasts should be compared in every particular

The nipple is palpated first, any induration observed and the character of any expressed secretion noted

The skin and subcutaneous tissues are then palpated, any superficial tenderness noted, and any swelling or induration felt.

The corpus mammæ is examined with particular care. The gland varies in size between wide limits, and in some cases it may extend from the level of the second to the sixth rib and from the lateral border of the sternum to the mid axillary line. The whole of this extent should be included in the examination.

Finally the axillary glands should be palpated, and sometimes the supraclavicular ones too

Examining a Lump in the Breast. If a lump is felt in the breast, the following points should be noted —

(1) Its size and shape.

(2) Its position (*a*) whether in, superficial to or deep to the corpus mammæ (*b*) whether close to or distant from the nipple (*c*) in which quadrant of the breast.

(3) Its outline—smooth (a cyst or a simple tumour) or irregular (chronic mastitis or carcinoma)

(4) Its consistency—soft like a lipoma or cold abscess, firm like a fibro-adenoma, tense and elastic like a cyst, tough and rubbery like chronic mastitis, stony hard like a scirrhous carcinoma.

(5) Its mobility (*a*) Does it move freely inside a capsule, independent of the breast, or is it fixed and integral with the breast? (*b*) Does it involve the skin, or does it, by attachment to the ligaments of Cooper cause dimpling when the skin is gently picked up? (*c*) Is it attached to the nipple? (*d*) Is it attached to the pectoral muscle? To test this, *observe the mobility of the lump while the patient contracts the pectoral* muscle by pressing her hand against the flank if the lump is fixed to the muscle its mobility along the line of the muscle fibres is restricted, although it may still be moved at right angles to that line.

(6) Its microscopic structure. Unlike all clinical criteria, this test is free from ambiguity It should never be neglected.

General Plan of Treatment for a Lump in the Breast. It must be recognised (*a*) that 80 per cent. *of all lumps in the breast are malignant,* (*b*) that carcinoma in the early curable stage presents no special features by which it may be diagnosed, and (*c*) that to delay treatment until the diagnosis is clear may cost the patient her life. It is therefore wise in a woman over 30 to regard any breast lump, unless manifestly benign, as probably malignant, and to treat accordingly As a general plan, the lump should be exposed through a small incision, and a portion removed for immediate frozen section. If not thereby *conclusively shown to be* benign, it should be treated by the radical operation. Even if the lump appears clinically to be entirely benign it should be an invariable rule to re-examine a month later and again after three months, for an early carcinoma may deceive even the most expert surgeon.

The advice given to the patient requires much thought, for she must be made to understand the importance of treatment, yet not be needlessly alarmed. Many women *fear the word "cancer" and associate it* with disseminated and incurable disease. For them it is probably

justifiable, both on ethical and philosophical grounds, to describe the disease as a tumour which would be very liable to become malignant if not removed The husband or other close relative must, of course, be given full information.

MALFORMATIONS OF THE BREAST

Amazia or absence of a breast and athelia or absence of a nipple are rare abnormalities.

Polymazia and polythelia (supernumerary breasts and nipples) on the other hand are common They are generally situated in or near to the primitive "mammary line," which extends from the nipple to the groin; rarely they are found elsewhere—for example on the back. They are usually functionless; rarely they cause pain and may require to be excised.

PHYSIOLOGICAL HYPERTROPHY OF THE BREAST

The breast exhibits a remarkable capability for proliferation and regression under the influence of hormones derived, it is thought, from the ovaries the pituitary and perhaps other glands. This is seen most strikingly during pregnancy and lactation, when innumerable new acini appear grow secrete and subsequently atrophy; but it also occurs in smaller degree, at every menstrual period giving rise to temporary engorgement of the breast and perhaps to a certain amount of discomfort.

It is believed that variations of these hormonal activities are responsible for a number of pathological lesions of the breast, including the so-called mastitis of infancy and adolescence diffuse hypertrophy of the breasts gynecomazia, and probably chronic mastitis.

Mastitis neonatorum is the term applied to a physiological hypertrophy which occurs in early infancy causing swelling and tenderness of the gland and sometimes leading to the secretion of a milky fluid. The condition resolves spontaneously and no treatment is required

Mastitis of Adolescence is a similar transient hypertrophy occurring about the time of puberty

Diffuse Hypertrophy of the breasts affects young girls and may lead to enormous enlargement of the breasts necessitating amputation.

Gynecomazia is a hypertrophy of the male breasts which are full and prominent, and in rare cases secrete a little watery fluid or even milk.

ACUTE MASTITIS AND MAMMARY ABSCESS

This is an acute bacterial infection of the breast, which nearly always arises during or shortly after lactation. The common time for a breast abscess is a week or two after lactation has begun. Occasionally both breasts are affected, simultaneously or in succession.

The staphylococcus aureus is the common infecting agent occasionally streptococci or other organisms. In some cases the infection enters through a cracked nipple, and reaches the gland along lymphatics more often, the nipple is intact and the infection must be presumed to have gained access along the milk ducts.

At the onset of the disease the breast becomes acutely congested, the milk clots in the affected lobes, and in this fertile pabulum the organisms proliferate with rapidity Suppuration with the formation of an abscess is the usual sequel. As in other staphylococcal infections necrosis is a prominent feature, and in late cases large sloughs form.

An abscess of this type is originally *intramammary*. As it spreads superficially it becomes *premammary* and may be of "collar stud" shape, with a small pocket in the mammary gland and a larger cavity subcutaneously. In other cases a premammary abscess results from a superficial skin infection and the corpus mammæ is unaffected.

A ***Retromammary Abscess*** is situated in the connective tissue plane deep to the breast and is usually not connected with the mammary gland, but derived from a diseased rib or from the spine or pleura. It may be due to acute pyogenic organisms, or to tubercle bacilli.



FIG. 188. Breast abscess, in a woman aged 32, originating on the tenth day after the onset of lactation. Under conservative treatment the infection has localised to a single large abscess and is now ripe for incision.

Clinical Features. At the onset of infection there is some malaise, and the breast feels hot, tense and tender. There is pain in the breast, intensified when the child suckles. Soon the pain assumes a throbbing character; the malaise increases, the temperature is raised, and the constitutional effects of toxæmia appear.

On examination, in the early stages the breast feels full and tense, and the affected lobules can be outlined as tender deep-seated swellings. The skin over the affected part is hot and red. Sooner or later the deep induration softens, and as the abscess approaches the surface fluctuation can be elicited.

Diagnosis. In the great majority of cases the diagnosis presents no difficulty. Very rarely a slow subacute abscess may be mistaken for an actively growing sarcoma, or *vice versa*.

Treatment. Penicillin should be given in full doses. The patient should be put flat in bed, with a low pillow, so that the full, heavy breast will not hang dependent. The breast should be supported by a firm bandage. Heat may be applied either by fomentations or an electric pad.

The child must be weaned. Hexoestrol dipropionate in doses of 15 mg is given to terminate lactation. If the unaffected breast fills with milk it should be emptied by a breast pump.

Under these conditions an abscess treated early may resolve. If it continues to develop operation should be delayed until it points, when it is readily opened by a small incision A finger must be inserted to ensure that all loculi are fully opened

In the case of a retromammary abscess the incision is made below the breast, along the inframammary fold to secure dependent drainage.

Residual Mastitis. Sometimes after an acute mammary abscess, a residual infection may persist for a long time. This is especially apt to occur after inadequate antibiotic treatment. There is a deep-seated tender lump composed of vascular fibrous tissue, and there may be a small, chronic abscess in its centre. One or more sinuses may discharge a watery secretion or even milk.

The condition gives rise to occasional pain in the breast. The lump may be mistaken for an area of chronic mastitis or for a tumour but the history generally indicates the diagnosis. The treatment in the first place is to 'bake' the part to endeavour to bring the abscess to a head This is best done, the patient being in bed, by means of a continuously applied electric heater Fomentations and poultices are of little use, for they cool within a few minutes of application If this treatment fails it is necessary to excise the whole inflammatory mass.

Fibro-cystic Dysplasia of Breast (Fibro-adenosis Chronic Mastitis)

This condition is thought to be due to the perverted action of hormones, probably ovarian, adrenal or pituitary in origin. Formerly it was called *chronic mastitis* and the term is still in use clinically but it is a misnomer and is misleading and should be given up In health the "mammatrophic" hormones (oestrogens and pituitary prolactin) exercise a variable influence on the mammary gland. At every menstrual period the terminal ductules undergo proliferation, while the same process takes place to a far greater extent during pregnancy and lactation Irregular and more persistent changes of a similar nature constitute the disease under discussion

By far the commonest form of this disease is called the *lobular* type. It occurs in young women and affects both breasts diffusely The patient complains of pain of a tingling or shooting character most marked in the premenstrual phase, and felt both in the breasts and radiating down the arms. On examination there is a fine granularity or a multitude of tiny tender nodules, corresponding to the proliferating buds of epithelial tissue in all parts of both breasts.

In this type of disease the diagnosis presents no difficulty and it has been established that there is no tendency whatever to malignancy No satisfactory treatment has yet been found, but as a rule the symptoms are not severe and the patient is mainly concerned with the risk of cancer As to this, she can be given complete reassurance. If the pain is considerable, some relief may be obtained by a belladonna plaster—the usual household remedy—or by supporting the breast with a bandage or strips of adhesive plaster

Cysts may develop as a part of the same disease process particularly in older women The cysts are due to dilatation of the ducts and

acini presumably as a result of partial obstruction of the ducts by epithelial overgrowth or fibrosis In some cases there is a single palpable cyst, with multiple small ones visible microscopically in other cases there are multiple palpable cysts in one or both breasts. They form smooth rounded tense mobile swellings. As a rule, they are entirely benign, but since they tend to enlarge and cause discomfort they should be removed. If there is a single palpable cyst it may be removed, along with the segment of mammary gland in which it lies, through a radial incision. If there are multiple cysts, the whole mammary gland should be removed This can be done through a submammary incision so as to preserve the nipple and areola intact.

The *lobar type* of this disease has occasioned much misunderstanding in the past. It is a disease in which the pathological process is more or less limited to one segment of one breast, which is fibrotic and contains dilated acini and ducts with small cysts and much epithelial prolifera tion. This type of disease is generally said to be precancerous, though the evidence for this assertion is not beyond doubt. Much more important, however is the *fact that this type of disease cannot readily be* distinguished clinically from a cancer The treatment, therefore, is on the lines laid down on p 884 with biopsy and examination of a frozen section as the first step If malignancy can then be excluded, the affected segment of the breast is excised.

TUBERCULOSIS OF THE BREAST

This rare condition is almost always due to local spread of the disease from a rib the pleura or an axillary gland, though there are exceptional cases in which the infection appears to be blood-borne.

In the commonest type, where the breast is involved secondary to disease of a rib the onset is insidious and painless A smooth spindle-shaped swelling develops along the line of the rib generally near its junction with the cartilage, and later the swelling fluctuates and a cold abscess tracks forwards into the tissues of the breast. The abscess may become loculated in the breast and may be mistaken for a cyst or a lipoma. Eventually it may come to the surface and form a sinus Similarly from tuberculosis of the pleura or of an axillary gland a *cold abscess may infiltrate the breast.*

The treatment varies according to the general and local condition present. A cold abscess should be opened and curetted and the wound closed. If a rib is responsible the affected part should be resected, if an axillary gland it should be excised. General tuberculous therapy should also be instituted. If the whole breast is riddled with disease, it should be removed provided the general condition is satisfactory

TRAUMATIC FAT NECROSIS

This very rare condition would have no practical importance, had it not, unhappily been introduced to the surgical literature as a mimic of breast cancer It is characterised by saponification of some of the fatty tissue related to the breast, as a result of some form of physical trauma, e.g by a blow or the pressure of a corset, or the injury produced by hypodermoclysis The saponified fat sets up a foreign *body reaction and stimulates* the growth of fibrous tissue, which leads to the formation of a lump in the breast. The lump is firm or hard and generally painless It is indefinite in outline, is fixed to the corpus mammæ, and, in fact, is indistinguishable from a carcinoma.

Diagnosis is usually not possible. Even the history of a *blow on the*

breast is not to be relied upon for such a history is often given by patients with carcinoma. Were diagnosis possible the treatment would be conservative, but in practice the treatment is as for a carcinoma.

SIMPLE TUMOURS OF THE BREAST

In addition to such tumours as lipoma, fibroma and angioma which may occur in any connective tissue, there are three important simple tumours peculiar to the breast—duct papilloma or intracystic papilloma, hard or pericanalicular fibro-adenoma, and soft or intracanalicular fibro-adenoma.

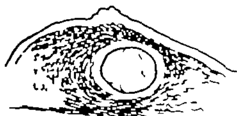
Duct Papilloma (Intracystic Papilloma). This is a simple papilloma growing in a dilated duct or cyst close under the nipple. It is of slow growth and generally painless. Often the only history is of a discharge of clear or bloodstained fluid from the nipple. On examination the cyst is felt as a smooth, tense, rounded swelling from which a few drops of fluid can be expressed at the nipple.

Generally the tumour is benign, but occasionally it may undergo carcinomatous change. This is suggested by the occurrence of blood stained discharge.

The treatment in most cases is to shell out the cyst along with the contained tumour after exposing it through an incision radial to the nipple. If the possibility of malignant change is entertained it is more satisfactory to remove the whole breast.



Hard or Pericanalicular Fibro-adenoma. This simple tumour is formed by an excessive proliferation of glandular tissue somewhat resembling that found normally in pregnancy. It is an encapsulated growth rarely larger than a walnut, and microscopically consists of a variable amount of fibrous tissue containing rounded acini lined by cubical epithelium.



The tumour generally occurs in young women. It may give rise to neuralgic pains in the breast or referred to the arm. On examination it is felt as a firm, rounded tumour which is very mobile within its capsule and slips under the fingers quite independently of the corpus mammæ.



FIG. 189 Simple tumours of breast. (a) Duct papilloma, (b) hard or pericanalicular fibroadenoma, (c) soft or intracanalicular fibroadenoma.

The treatment is to remove the

tumour by shelling it out from its capsule, through an incision radial to the nipple

Soft or Intracanalicular Fibro-adenoma. This uncommon tumour consists of young connective tissue projecting in cauliflower fashion into the mammary ducts, so that it forms numerous processes, each covered with the flattened ductal epithelium and widely adherent so



FIG 190. Soft (intra canalicular) fibro-adenoma, of three years duration, in a woman aged 52. The large size and cystic character of the tumour are evident.



FIG. 191 Intracanalicular fibro-adenoma of the breast, in a woman aged 55 years. The tumour had occupied a cyst and had recently fungated through the overlying skin. Although of malignant appearance it was quite soft and mobile, and proved on microscopic examination to be benign.

that there is connective tissue of an almost myxomatous appearance, containing slit like spaces lined with flattened epithelium. Often the tumour becomes partly cystic.

The tumour is of firm consistency and mobile. When extensively

cystic it may reach a very large size (Fig 100) and it may even fungate and assume an appearance of malignancy (Fig 101)

The treatment in the early stages is to shell the tumour out of its capsule. Later, when the whole breast is occupied by the tumour, it should be removed complete.

CARCINOMA OF THE BREAST

This is one of the commonest of all malignant tumours sharing this distinction with carcinoma of the uterus.

Pathological Features Practically all carcinomata of the breast arise from the epithelial lining of the duct system, and especially from the terminal ducts and acini, whose cells, being subject to periodic proliferation and regression, are less stable than those in other regions

At first the proliferating cells grow into the lumen of the affected duct, giving rise to a condition known as *intra-duct carcinoma* This is a stage of great pathological importance, but is not recognisable clinically

The next stage is seen when the cells penetrate the basement membranes and invade the tissue spaces and lymphatics. In most cases the cells lose their acinar arrangement, and by mutual pressure assume a spheroidal shape. The common spheroidal-cell carcinoma of the breast consists of strands or masses of spheroidal epithelial cells, set in a stroma of dense connective tissue (scirrhous carcinoma)

The malignancy of a breast tumour depends to some extent upon the functional activity of the gland Thus, in an atrophic breast, the tumour is generally fibrotic and slow-growing (atrophic scirrhous) whereas in a well-developed breast, especially in a young woman it is large, soft and rapidly growing (encephaloid carcinoma) In a breast at the height of its functional activity in pregnancy or lactation, a carcinoma progresses with extreme rapidity and may be fatal within a few months (acute carcinoma)

Scirrhous Carcinoma of the Breast

This, the commonest type, may occur in any part of the breast. The commonest site is the upper lateral quadrant, which is the largest quadrant. It must be remembered that the actively functioning breast may extend from the second rib to the sixth rib from the lateral edge of the sternum to the mid-axillary line, and upwards as far as the axilla A carcinoma may occur at any point within these boundaries. Sometimes a carcinoma arises in both breasts, simultaneously or in succession

Typically a scirrhous growth is of small size and stony hardness, has no capsule and infiltrates the breast tissue in all directions. When cut across it may be so hard as to impart a creaking sensation to the knife. Its cut surface is of pinkish grey colour and presents pale streaks of fibrosis and yellow spots of necrosis, like an unripe pear

Microscopically the tumour consists of strands or masses of

spheroidal epithelial cells embedded in a plentiful stroma of connective tissue.

Clinical Features. A scirrhous carcinoma is rare before 30 thereafter its incidence increases with the years. It is generally symptomless in the early, curable period and in most cases the lump in the breast is discovered accidentally

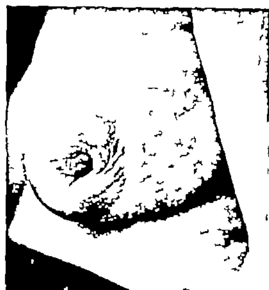


Fig. 192. Carcinoma of the breast in a woman aged 47 Although the lump had been noticed only a week previously the disease was far advanced. Note the retraction and elevation of the nipple and the dimpling of the skin over the tumour



Fig 193. Advanced scirrhous carcinoma of the breast. The nipple is retracted and elevated.

Examination of the breast at an early stage will reveal a small lump usually rather hard but possessing no other characteristic feature. It is important to recognise that all the signs formerly described as typical of cancer of the breast are in fact signs of *late* cancer

Fairly early in the course of the disease the skin over the tumour is tacked down, as the disease pulls on the fibrous bands connecting the

deep surface of the skin with the corpus mammæ The dimpling is seen best if the skin is moved from side to side over the tumour This sign is not evident when the tumour is directly deep to the nipple.

Retraction, and later elevation of the nipple, due to the disease spreading along the major milk ducts, is seen when the tumour is located close under the nipple.

In later stages other signs appear The growth may ulcerate at the surface, or the skin may be infiltrated like pig skin (*peau d'orange*), and the glands in the axilla may be enlarged

Diagnosis Success in the treatment of carcinoma of the breast is almost entirely dependent upon early diagnosis, and it is lamentable that in spite of the superficial situation and characteristic features of the growth so many cases have passed the curable stage when first seen

It is most important to recognise that the tumour is quite symptom less in the early curable stage, and that such obvious signs as marked retraction of the nipple or the presence of hard axillary glands are only to be found in the later stages. The curable cancer of the breast is a symptomless lump which is usually hard, but does not necessarily have any other special characteristics. These features alone are sufficient indications for operation while if in addition the nipple is retracted to the slightest degree, or if the overlying skin dimples when pinched up the diagnosis is well nigh certain

In atypical cases there may be difficulty in diagnosing a carcinoma from a focus of chronic mastitis, a simple tumour or even a cyst. The more expert the surgeon the more prone he is to confess uncertainty

In a woman over 30, every lump in the breast should be regarded as cancer unless proved otherwise by microscopic examination (p 334)

Spread of Cancer of the Breast. Cancer of the breast spreads by lymphatics and by the blood stream. In most cases lymph spread occurs first in the direction of the axilla, involving first the lymph glands of the pectoral group (on the medial wall under cover of the pectoralis major) and then to glands on the posterior wall and towards the apex of the axilla.

In about 30 per cent. of cases, and particularly where the growth is in the medial segments of the breast, spread occurs early to lymph glands along the internal mammary artery in the anterior mediastinum. Later supraclavicular glands are involved.

Spread of the disease by the blood stream probably occurs much earlier than was formerly thought, but fortunately many malignant cells dispersed in this way fail to take root and are destroyed. It is believed that rough handling of the tumour during operation, or even from palpation during examination, may disseminate cells in this way

Blood borne metastases show striking site propensities. For obvious reasons the lungs are often involved, but often they escape, for the malignant cells may pass through the pulmonary capillary bed. By far the commonest site is the skeleton, and eventually every bone in the body may be infiltrated and replaced by disease. The liver and brain

are involved late Contrariwise, the spleen and the voluntary muscles are almost completely immune.

In the examination of a patient with cancer of the breast, attention is first directed to the axilla. The examiner should stand on the opposite side (so that he can palpate the medial wall with the flat of the fingers) and the patient must allow her arm to hang at the side to relax the axillary fascia

After the axilla, the root of the neck is palpated then the opposite breast, axilla and neck.

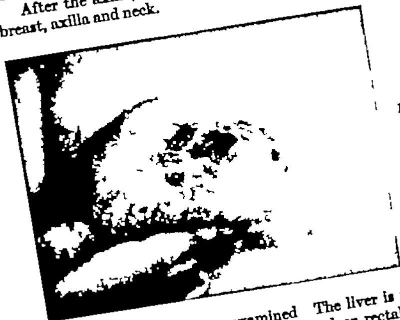


Fig 194. Carcinoma of breast with extensive skin involvement.

The abdomen is then examined The liver is palpated, evidence of peritoneal exudate sought, and vaginal or rectal examination carried out in search for metastases on the ovaries.

X ray examination of the chest should be carried out, in case of metastases in the lungs or fluid in the pleural cavity X ray examination may also be made of the ribs, dorsal spine, lumbar spine and pelvis, where bony secondaries are often seen first.

Staging of Breast Cancer It is customary to recognise four stages of breast cancer·—(1) The cancer is limited to the mammary gland and the skin immediately over it. (2) It has spread to the axillary glands but no further (3) It has undergone wide local spread with a large mass in the breast extensively involving skin or muscles. (4) It has undergone distant dissemination Clearly in the first and second stages it should be invariably cured by the radical operation, but in fact nearly 30 per cent. of patients supposedly in stage (1) and over 50 per cent. of patients supposedly in stage (2) prove later to have had widespread dissemination A method of measurement with such a margin of error is of doubtful value.

Treatment. In all cases with no definite evidence of wide dissemination the routine treatment is to perform a radical mastectomy which consists in removing the whole mammary gland, an ellipse of overlying skin including nipple and areola, a large circle of deep fascia, the greater

part of the pectoralis major muscle and the whole pectoralis minor muscle, and finally the axillary glands and connective tissues. If the disease is locally extensive a large circle of skin is removed, and the gap covered by split skin grafts Some surgeons in addition explore the anterior mediastinum (after dividing the costal cartilages and retracting the ribs away from the sternum) to remove glands along the internal mammary artery

As a routine, in many hospitals radiotherapy is applied postoperatively to the breast area, axilla and mediastinum Where the disease is locally extensive, preoperative radiotherapy is sometimes advised to bring the tumour down to operable proportions

In recent years there have been many criticisms of this orthodox plan of treatment. The argument is that if the disease is confined to the breast it can be removed by a simple mastectomy while if it has spread beyond the confines of the breast it is probably disseminated widely and therefore too advanced for a radical mastectomy

Considerations of this sort may have determined the plan of treatment initiated by McWhirter in Edinburgh, in which in all cases a simple mastectomy is performed, and followed by very heavy radiotherapy This method seems to give as many cures as the orthodox treatment, but it has not found general favour owing to the severity of the reaction and the frequency of complications.

The Endocrine Treatment of Late Breast Cancer

Beatson in 1896 found that removal of the ovaries sometimes leads to a remarkable though temporary arrest of the progress of late breast cancer Similar results have been obtained by administering hor



FIG. 193 Recurrent cancer four years after mastectomy with ulcerating growth in line of operation scar and a metastasis in the sternum. A case for endocrine ablation.

mones. Male hormone (testosterone) has been recommended for women before the menopause but its masculinising effects on the voice, on the growth of hair and on the psychological character are sometimes very disturbing For women who have reached the menopause, œstrogens such as stilbœstrol have been used with benefit. However all these methods have now been displaced in favour of the following —

Oophorectomy and Adrenalectomy This operation is believed to act by eliminating the œstrogens, though at the present time there is some doubt as to whether this is the true explanation In 60 per cent.

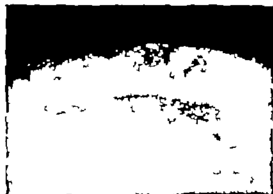


Fig. 190A. Cancer of breast. Metastases in clavicle, before adrenalectomy

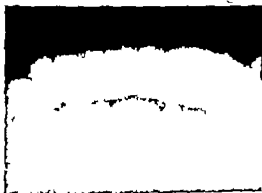


Fig 190B. Three months after adrenalectomy showing recalcification.

or 70 per cent. of cases it is quite ineffective in the remainder it causes a dramatic regression of the disease, which begins in a few days and may persist for many months, or even a few years. The operation is performed in two stages at the first, the ovaries and one adrenal are removed, at the second a week or two later the other adrenal gland In women several years past the menopause the ovaries can be left in place. Before operation cortisone is given (100 mg by mouth) for two days. After operation three times this amount is given for a few days. Subsequently a maintenance dose which varies from 50 mg to 100 mg must be given daily without fail, or acute adreno-cortical deficiency will develop The blood pressure must be checked every fifteen minutes for several hours after operation, and if hypertension develops a noradrenalin drip must be given Later a large intake of salt must be provided

Hypophysectomy or Yttrium Implantation. As an alternative to adrenalectomy or in cases where adrenalectomy has failed, the pituitary gland may be removed or destroyed by radioactive isotopes. It is believed that these procedures may act by eliminating A.C.T.H. (and thus causing the adrenal cortex to atrophy) and also by eliminating the secretion of prolactin. The operation of hypophysectomy is carried out from above through a frontal bone-flap incision which gives access to the roof of the sella turcica. The pituitary gland is then removed by means of curettes. It is a difficult procedure, with some risk of damage to the optic nerve, and the resection is often incomplete.

Yttrium implantation is carried out by means of cannulas inserted under X-ray visualisation through the nostrils and the sphenoidal air sinus into the lower part of the sella. Yttrium emits beta rays which destroy the pituitary gland without damage to more distant structures. The method is still under trial.

Carcinoma of the Male Breast. Carcinoma of the male breast is rare. It occurs most often in the subjects of gynecomazia or as a complication of a simple tumour or chronic mastitis.

The growth is generally a scirrhous carcinoma, and its clinical features are similar to those in the female. Since the male breast is of small size the tumour soon invades skin and pectoral muscles and spreads to the axillary glands. For this reason the prognosis is more grave than in the female. The treatment is by operation or, failing that, by radiotherapy.

Sarcoma of the Breast. This is a rare growth which accounts for only about 3 per cent. of breast tumours. It may arise *de novo* or may represent malignant change in a pre-existing fibro-adenoma of intracanalicular type. The latter type is sometimes described as adeno-sarcoma.

In either type there is a rapidly growing tumour which infiltrates the breast widely and soon spreads to the lungs and viscera. It is to be diagnosed from a rapidly growing fibro-adenoma, an acute carcinoma or a subacute abscess in the breast. The treatment is by operation, or failing that, by radiotherapy.

PAGET'S DISEASE OF THE NIPPLE

This rare disease of elderly women is characterised by an eczematous ulceration of the nipple, which is invariably accompanied or followed by the development of a carcinoma in the underlying breast.

The eczematous condition starts at the nipple and slowly, in the course of months or even years, spreads to the areola and surrounding skin. It is of florid appearance, well defined at its margin and with a finely granular surface. It may be covered with dry scales, or may ooze a watery or bloodstained exudate. Microscopically the nipple lesion is characterised by ulceration of the superficial layers of the epidermis and proliferation of the basal layers. A striking feature is the presence of "Paget cells"—large *rounded* cells of hydropic appearance lying in groups among the prickle cells of the rete Malpighii of the *epidermis*.

The carcinoma is usually a *typical scirrhous* growth. It generally appears *coincidently* with the nipple lesion, but occasionally remains latent for several months or even years.

The nature of Paget's disease is not fully understood. The theory most widely held is that propounded by Muir who considers that both the nipple lesion and the carcinoma are sequels to an "*intraduct carcinoma*" (p. 341). On this theory the Paget's cells in the epidermis are tumour cells which have originated in one of the main milk ducts close to the nipple and invaded the

epidermis directly their peculiar hydropic appearance is due to the reaction of the healthy epidermal cells The underlying carcinoma is believed to arise from a similar intra-duct lesion which has invaded the deeper part of the breast.

The diagnosis is to be made from simple dermatitis which occurs in younger women and rapidly responds to simple treatment.

The treatment is to perform radical mastectomy whether a tumour is palpable in the breast or not.

CHAPTER 30

THE THORAX

INJURIES TO THE CHEST

NON-PENETRATING injuries to the chest are common as the result of direct blows or crushes. Penetrating injuries, fortunately less common, result from wounding by sharp weapons or high-velocity missiles.

Crush Injuries. The extent of the damage varies greatly The mildest form is a contusion of the chest wall, with bruising but no other damage. Fracture of a rib commonly results from a direct blow, and is usually without serious effects. Fracture of several ribs frequently occurs as a result of crush injuries, and is apt to be associated with damage to the lung This damage is not necessarily serious but it often leads to such complications as subcutaneous emphysema, pneumothorax or hæmothorax.

Penetrating Injuries. Here the extent of the damage varies according to the size, depth and direction of the wound When the wound opens the pleural cavity widely there is immediate danger to life, while later there is danger of hæmothorax and empyema. When the wound involves the lung there is the added risk of valvular pnemothorax or of rapidly fatal hæmorrhage.

General Treatment of Chest Injuries. In contrast to abdominal injuries, the treatment should usually be conservative operation should be undertaken only in the presence of clear indications and should then be of as limited scope as possible.

The patient is propped up morphia is given in large doses to relieve the severe pain and diminish respiratory embarrassment, oxygen is administered if the patient is cyanosed, and shock (often severe) is treated. Active treatment is indicated immediately to close an open pneumothorax or to excise a wound of the chest wall and may be indicated later for hæmothorax or empyema. A careful watch must be kept for these complications. It must be remembered also that severe chest injuries may be complicated by other lesions such as fracture of the spine, rupture of the diaphragm or injury to the abdominal viscera.

TRAUMATIC ASPHYXIA (TRAUMATIC CYANOSIS)

This condition occurs in young persons who have been subjected to sudden severe compression of the thorax, e g by being squeezed in a dense crowd or crushed under a heavy weight. It is characterised by swelling and purple suffusion of the skin of the face, head and neck, down to or below the level of the clavicles and is due to sudden over-distension of the veins which are unprotected by valves In addition, there may be bleeding from the nose and ecchymoses into the subconjunctival tissues or into the retina. The latter lesion may cause temporary or permanent blindness.

The swelling and discoloration of the skin pass off within a few days with little evidence of bruising No treatment is required

FRACTURE OF THE RIBS

Fracture of the ribs is a common injury The following types are most common —

(1) A direct blow generally breaks a single rib, or two at the most. The fracture occurs at the point struck, and the fragments are forced inwards. They may wound the pleura and lead to hæmothorax, or may even wound the lung and lead to hæmoptysis, interstitial emphysema and pneumothorax.

(2) A crush injury of the thorax may break several ribs, especially those over the middle of the thorax (fourth to eighth) The ribs generally break at their points of maximum convexity just in front of their angles. The fragments at the site of fracture are generally forced outwards, but the parietal pleura may be torn and hæmothorax result. Pneumonia is very apt to supervene

(3) Rarely a sudden muscular contraction, e.g in sneezing or coughing may break a rib The fracture generally occurs near one end of the rib and there is no displacement.

The clinical features are characteristic. At the time of the injury the patient may experience a sudden snap and this is followed by a sharp localised pain, intensified by respiratory movement or by coughing or sneezing To minimise the pain the respiratory excursion is restricted and breathing is rapid and shallow Tenderness can be elicited by pressure over the site of fracture, or by squeezing the chest. It is sometimes possible to elicit crepitus. The fracture can generally be demonstrated by X ray

The treatment is to immobilise the rib as far as possible by adhesive strapping so as to minimise the pain To do this, broad strips of adhesive strapping are applied so as to encircle the thorax completely at the level of the fracture, and for 2 or 3 inches above and below the strapping being applied during full expiration, and as tightly as possible. The strapping should be kept in position for two weeks the fracture heals rapidly

In severe cases a hæmothorax may require aspiration The risk of pneumonia must be kept in mind

INTERSTITIAL (SURGICAL) EMPHYSEMA

This affection may result from a contusion of the lung or a penetrating wound of the lung

In the common form, which may result from a comparatively small injury to the chest, some of the pulmonary alveoli are *ruptured, and air* leaks out into the mediastinum and percolates thence into the subcutaneous tissues of the neck and the chest wall. The affected tissues are swollen, sometimes markedly so and are crepitant. The air bubbles *may be demonstrated by X rays.*

The emphysema may give rise to temporary dyspnœa, but rarely



Fig 197 Interstitial emphysema arising after an operation on the lung The air has percolated up in the connective tissue planes of the neck and reached the cheeks and eyelids, which are bloated and crepitant. In this case the emphysema persisted for a week.

leads to more dangerous symptoms. Usually it is absorbed rapidly, and disappears within a few days. No treatment is required

PENETRATING WOUNDS OF THE CHEST

Penetrating wounds present many special features, which vary according as the wound involves the pleura alone the pleura and lung or the heart.

Open Wounds of the Pleura. In an open wound of the pleura, air fills the pleural cavity the elastic lung collapses, and an open pneumothorax results (p. 352) There is severe shock, which is progressive owing to loss of body heat from ventilation through the wound. In addition, there is grave impairment of the circulation owing to mediastinal flutter a to-and fro movement of the mediastinum at every respiration which greatly embarrasses the heart's action

The immediate treatment is to apply a large moist pack over the wound in order to convert the open pneumothorax into a closed one. Later under anæsthesia, the wound is cleansed, its margins excised and sutures inserted to give an air tight closure. A water-seal drain is introduced through a small counter incision.

Wounds of the Lungs. The lung may be penetrated by a stab or a bullet wound. Such a wound is generally small and valvular and its superficial part rapidly becomes sealed off preventing the formation of an open pneumothorax. Bleeding occurs from the damaged lung and may cause hæmoptysis or hæmothorax. Later pneumonia may supervene, and if a foreign body remains embedded there is a grave risk of a lung abscess. The treatment is to cleanse and close the wound in the chest wall and to treat such complications as hæmothorax, pneumonia and abscess as they arise.

At the present time empyema is seen most commonly as a complication of diseases such as bronchial carcinoma and in the late stages of carcinoma of the œsophagus It may also follow thoracic injuries and is a well recognised complication of thoracic operations.

If the infection is gradual in onset there is time for adhesions to develop between lung and parietes, and the empyema then assumes the form of a localised abscess. It gives rise to toxic effects and if large it may exercise pressure upon the lung, heart and mediastinum If the infection is rapid in onset there is no time for adhesions to form and a free pleuritis results, with watery pus diffused through the pleural cavity In such a case the toxæmia is more pronounced, the lung undergoes collapse and the pressure effects are greater

The treatment of empyema in the first place is by the appropriate antibiotic. If pus collects, it should be aspirated by needle. If after repeated tapping pus continues to collect, a portion of a rib should be resected to allow free drainage. Generally access is best gained by an incision over the eighth rib in the posterior axillary line. The rib is exposed, its periosteum incised and reflected, and a portion of the rib 2 to 3 inches long is removed A large rubber drainage tube is inserted into the cavity

Chronic empyema is generally attributable to some underlying disease, such as tuberculosis or bronchial carcinoma, or it may follow a thoracic operation such as pneumonectomy particularly if there is a persisting broncho-pleural fistula.

The cavity of a chronic empyema is generally situated behind the lung, along the paravertebral gutter and it may be considerably larger than is indicated by the amount of pus discharging from the tortuous sinus The position and size of the cavity can be gauged most accurately by radiography (Plate XII *opposite*) If desired lipiodol may be injected into the cavity to act as a contrast medium

The treatment in the first place is to establish wide drainage by resecting portions of two or more ribs and inserting a large drainage tube Subsequently the cavity is washed out with eusol or Dakin's solution If these measures do not suffice it is generally necessary to perform *Schede's operation which* consists in removing the whole roof of the cavity including ribs intercostal tissues and thickened parietal pleura so that the overlying tissues can fall in and obliterate the cavity In rare cases an alternative method is to decorticate the lung by dividing the thickened visceral pleura so as to allow it to expand. The end results are frequently disappointing

ABSCESS IN THE LUNG

An abscess in the lung generally occurs (1) as a complication of pneumonia especially post-operative pneumonia or of a small infarct in the lung (2) as a result of infection round a foreign body in a bronchus e.g a nut or pea, or a fragment of tooth or tonsil inhaled during anæsthesia. The infection is often a mixed one, with pneumococci streptococci and anaerobic organisms.

The abscess is generally situated near the mediastinal aspect of the lung especially on the right side. At first it is a closed cavity but it soon ruptures into a bronchus and the pus is coughed up If the consequent drainage is sufficiently free, the cavity heals promptly but more often the track into the bronchus is of small calibre, drainage is inadequate and the abscess becomes chronic. Rarely it may leak into the pleural cavity and give rise to empyema, often of grave type.

PLATE XII



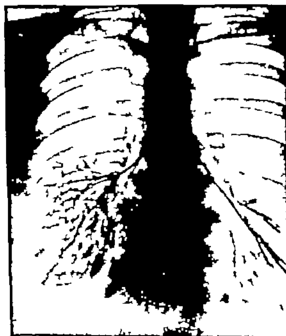
Acute empyema. The heart is displaced to the right.



Chronic empyema.



Artificial pneumothorax for tuberculosis. Collapse of the lung is prevented by apical adhesions.



Bronchiectasis. The cylindrical cavities are visualised by lipiodol.

[To face p.

The clinical features typically, are those of a severe illness with rigors and a high remittent temperature together with a troublesome cough In favourable cases there is sooner or later a sudden expectoration of pus followed by rapid improvement. In chronic cases the cough persists and the purulent sputum increases in amount, owing to the secondary development of bronchiectasis. If the suppuration continues, waxy disease may supervene or a brain abscess may occur

The diagnosis is confirmed by radiography, which demonstrates the cavity with its layer of pus, surrounded in most cases by a zone of induration A foreign body, if opaque, may also be seen

In most cases the abscess heals rapidly under conservative treatment. If healing is delayed bronchoscopic examination is advisable. If a foreign body is present, it may then be located and removed while if there is no foreign body it is sometimes possible to relieve the condition by bronchial lavage.

Rarely is it advisable to collapse the lung by artificial pneumothorax, or even to drain the abscess externally

BRONCHIECTASIS

This disease is generally a sequel to pneumonia, especially broncho-pneumonia complicating measles or whooping cough Less often it follows aspiration of a foreign body into the bronchi The bronchial dilatation is caused by inflammatory destruction of the mucous membrane, and the resulting cavities may be more than twice the calibre of normal bronchi.

Bronchiectasis generally involves the lower lobe, especially in its medial part, and is often bilateral. It may be associated with a chronic indurative inflammation of the corresponding lobe and with extensive pleural adhesions.

The disease is chronic, and the main features are attacks of coughing followed by the expectoration of large quantities of foul smelling pus. In the later stages clubbing of the fingers is a marked feature. Death may result from pneumonia or from brain abscess, two common complications

The diagnosis is confirmed by radiography after the intra tracheal injection of lipiodol, which outlines the dilated bronchi (Plate XII facing p 354)

The treatment in an early case includes postural drainage, for which the patient is tilted head downwards several times a day to empty the dependent cavities. In addition, the cavities should be washed out from time to time by bronchoscopic lavage.

In more advanced cases lobectomy may be advised.

TUBERCULOSIS OF THE LUNG

Surgical treatment is indicated in a limited number of cases of pulmonary tuberculosis in which a focus of active disease persists despite full antibiotic treatment. Formerly many methods were in vogue to facilitate shrinkage of the fibrotic lobe and to ensure physiological rest to the diseased tissues. These objects were gained by

various types of collapse therapy *Artificial pneumothorax* was the method of widest application A needle was inserted into the pleural cavity and a measured quantity of air allowed to enter the alteration in intrapleural pressure being carefully checked by means of a water manometer connected with the needle. Since the air was gradually absorbed, the pneumothorax had to be refilled at intervals of a week or so, the length of interval being increased perhaps to a month or more in the later stages of treatment. *Thoracoplasty* consisted in removing sections of all the fixed ribs at two or more operations, so that the whole side of the chest can fall in, to permit collapse of the lung It is now rarely used.

At the present time, in the few cases requiring operation it is generally necessary to perform partial pneumonectomy The operation is performed under streptomycin cover the lung is exposed by a suitable incision through one of the higher intercostal spaces, and a part of the affected lobe is removed.

BRONCHIAL CARCINOMA

This is the commonest primary tumour arising within the lungs, although occasionally simple tumours are encountered.



FIG. 196. Bronchogram, showing complete block of left main bronchus by carcinoma.

Bronchial carcinoma is thought to be related to cigarette smoking and to be increasing in frequency at the present time. It generally arises from the mucous membrane of one of the larger bronchi close to the root of the lung Microscopically it is of diverse appearance, and may be composed of columnar, squamous or oat shaped cells (small undifferentiated cells with deep-staining nuclei and scanty cytoplasm)

The growth is of invasive character involves adjacent lung tissue and often gives rise to multiple metastases, especially in lymph glands and in bones. Pneumonia and empyema may occur as complications.

The clinical features are insidious and often obscure. Generally the main feature is a troublesome cough, increasing in severity and associated with loss of weight and general ill health. Hæmoptysis is common. In the late stages there are dyspnœa, increasing debility and emaciation.

Not infrequently the primary growth is symptomless, and attention is drawn to the disease by a metastasis, e.g an enlarged gland in axilla or neck, or a tumour in bone, which may occur in any part of the skeleton

The diagnosis is assisted by radiography which demonstrates an area of opacity corresponding to the collapsed lobe. Radiography after intra trachial injection of lipiodol will, in addition demonstrate the bronchial stenosis. Bronchoscopy may reveal the growth and enable a small portion to be removed for histological examination

The treatment in favourable cases is by pneumonectomy If this cannot be done, X ray therapy may be used as a palliative.

MASSIVE COLLAPSE OF THE LUNG

This condition is one of the commonest of chest complications. Most often it follows operations on the upper abdomen but it may develop after an injury to the thorax, or even after a fracture or severe injury to other parts of the body

The cause of massive collapse is a sudden obstruction of a major bronchus by a plug of tenacious mucus. Probably in some cases the bronchus is also narrowed by reflex spasm or by œdema, inflammatory or allergic. When the bronchus is obstructed the pent up air is rapidly absorbed and the affected lobe collapses.

Massive collapse most commonly affects the lower lobe. When the lung shrinks it cannot retract from the chest wall, for this would involve the creation of a vacuum in the pleura. The diminished volume of tissue within the affected side of the chest is compensated by displacement of the mediastinum and heart to that side.

The clinical features are striking and characteristic. The collapse occurs abruptly generally within twenty four to forty-eight hours of operation. It causes marked respiratory distress, with a feeling of tightness across the chest, severe dyspnœa, a rapid respiratory rate and some cyanosis. Cough is slight and there is little or no sputum. The

temperature is raised often to 100 or 101° F and the pulse rate is increased On examination, the respiratory excursion is diminished on the affected side, and there is dullness on percussion with faint breath sounds and diminished vocal fremitus. If the collapse is massive the heart is displaced towards the affected side. Radiography confirms the diagnosis.

Though distressing pulmonary collapse is not dangerous, and usually it terminates spontaneously often after a sudden movement or fit of coughing, which releases the plug of mucus. For this reason during the immediate post-operative period the patient should be made to move actively in bed, and to cough up any mucus which collects. After an abdominal operation the pain may be diminished by applying pressure to the rib margin while the patient coughs.

Treatment should be instituted as soon as the condition is recognised Inhalations of steam and menthol should be given to loosen the plug of mucus, and carbon dioxide should be administered to stimulate respiration in order to dislodge it. In some cases the plug may be removed by suction through a bronchoscope.

PULMONARY EMBOLISM

Pulmonary embolism is a well recognised complication in middle-aged or elderly people who are seriously ill and confined to bed but it is of particular interest to surgeons as a post-operative complication, especially after operations on the abdomen or pelvis.

The primary lesion is post-operative thrombophlebitis, which is generally situated in the left femoral or iliac vein or in one of the veins of the pelvis (p 95) A fragment of the clot later becomes detached and is carried in the blood stream to the right side of the heart and thence to the pulmonary artery

Pulmonary embolism occurs at any time from twenty four hours to a few weeks after operation The commonest time is from eight to twelve days after operation.

Premonitory symptoms occur in some cases. Often there is nothing definite, except that the patient is not quite as well as he should be there may be an occasional slight rise of temperature, or he may sleep badly or complain of pains in the abdomen or legs. It is a remarkable fact that in most cases there is no obvious thrombophlebitis the patient with an œdematous "white leg rarely sustains an embolism.

The symptoms vary according to the size of the embolus. A small embolus lodges in a small branch of the pulmonary artery and gives rise to an infarct in the lung There is a sharp pleuritic pain with dyspnœa, the pulse rate is raised and there may be a tinge of cyanosis. A day or two later the diagnosis is made clear when he spits up a little bloodstained sputum. In most cases the symptoms settle in a few days, or pneumonia may supervene.

A large embolus lodges in one of the major branches of the

pulmonary artery causes a sudden crisis with intense praecordial pain marked dyspnoea and cyanosis, and proves fatal in a few minutes, or at the most a few hours. A still larger embolus lodges in the main pulmonary artery and causes instantaneous death

The treatment is to give heparin (p 90) It is highly effective in minor embolism, and if, given promptly in adequate doses (15,000 units intravenously), will avert death in all but the most severe types. In addition a poultice or kaolin pack is applied to the chest and a large dose of morphia is given to diminish restlessness and mitigate the pain

PATENT DUCTUS ARTERIOSUS

The ductus arteriosus connects the aorta just beyond the left subclavian artery to the main stem of the pulmonary artery In foetal life blood from the pulmonary artery passes *via* the ductus to the descending aorta and thence to the placenta. After birth if the ductus remains patent the blood flow is reversed and as a result the pulmonary artery undergoes dilatation. There are no symptoms in early childhood but later growth is impaired and evidence of cardiac failure may develop The picture may be complicated by subacute bacterial endocarditis affecting the pulmonary artery at the point of inrush of the aortic blood. The diagnosis is based upon the presence of a continuous "machinery murmer audible below the medial end of the left clavicle. Operation should be advised, preferably in childhood or adolescence. Access is gained *via* the left pleural cavity and silk ligatures are applied to occlude the ductus.

COARCTATION OF THE AORTA

This is a congenital narrowing of the aorta, believed to be due to an extension of the fibrotic process concerned with closure of the ductus arteriosus. The stricture, which is situated a short way distal to the left subclavian artery varies both in length and in tightness. In severe cases it leads to cardiac hypertrophy and thus to hypertension, which is limited to the upper limbs and the upper part of the trunk, while in the lower limbs the blood pressure is lowered. The main symptoms are headache, due to the hypertension, and coldness of the feet, due to the reduced blood flow In severe cases cardiac failure supervenes in early adult life, while cerebral vascular accidents may occur

The diagnosis is based on the differential blood pressure readings, on the presence of abnormal pulsation due to the large collateral channels especially along the scapular margins, and on X ray evidence of rib notching due to the pressure of dilated intercostal arteries At operation the aorta is exposed through the left pleural cavity lightly clamped above and below and the narrow part resected, the two ends being then joined by fine silk sutures. The operation is made difficult by the presence of numerous dilated collateral vessels.

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CONGENITAL PULMONARY STENOSIS

The embryonic heart consists of two chambers, an auricle and a ventricle, the latter opening into a single arterial bulb Later each is divided by a septum and similarly the aorta is separated from the pulmonary artery Septa incompletely formed and displaced to the right give rise to the complex congenital anomaly of which pulmonary stenosis is the main feature.

The stem of the pulmonary artery is narrowed while the aorta is unduly large and displaced to the right. The interventricular septum is defective, permitting a flow of blood from the right to the left ventricle This combination of pulmonary stenosis, dextroposition of the aorta, enlargement of the right ventricle and a patent septum is known as the tetralogy of Fallot.

Clinically there is extreme cyanosis ('blue baby') since little blood reaches the lungs, and there is severe dyspnœa on exercise.

The treatment devised by Blalock and Taussig was to construct an artificial ductus arteriosus by anastomosing one of the main branches of the aorta (e.g right subclavian artery) to the right or left pulmonary artery thus passing an adequate supply of blood into the pulmonary circulation. The technical difficulties of this operation are increased, and the outcome rendered uncertain, by the frequent coexistence of other congenital anomalies. For stenosis involving the pulmonary valve Brock has devised a more direct attack in which an instrument carrying a concealed knife is inserted through the wall of the right ventricle so that the stenotic valve can be incised from within A similar instrument is used for stenosis involving the infundibulum of the right ventricle.

MITRAL STENOSIS

This common sequel to rheumatic endocarditis is now often suitable for surgical treatment, which is especially indicated in patients with severe disability particularly those liable to attacks of acute pulmonary œdema.

Access is gained to the left pleural cavity by way of the fourth interspace, and the pericardium is opened just in front of or behind the phrenic nerve. A purse-string suture is inserted to encircle the left auricle (auricular appendage) which is then opened at its tip to admit a finger The valve may be stretched, so that it tears at one of the com missures, or it may be incised by a guarded knife guided by the finger In some cases the finger inserted in this way is used to guide a special dilator inserted through a stab incision near the apex of the ventricle

ELECTIVE CARDIAC ARREST

In recent years two techniques have been evolved which enable the heart beat to be arrested completely for many minutes, so that the heart chambers can be opened and septal defects repaired These

techniques are the artificial heart pump and the use of hypothermia The latter also has a valuable place in operations involving temporary arrest of the cerebral circulation or of the renal circulation

Several types of artificial heart pump are in use experimentally The patient is heparinised and the machine is primed with several pints of stored blood The machine takes blood from the venæ cavæ and drives it through an oxygenator and then into the systemic arterial circulation Oxygenation may be obtained by injecting a stream of oxygen bubbles (a defrothing device is then necessary before the blood is returned to circulation) or by passing the blood through fine semi permeable polythene tubing in an atmosphere of oxygen

The use of hypothermia is based on the fact that at low temperatures the metabolic requirements of the brain, kidneys and other vital tissues (including the heart muscle itself) are so reduced that they can survive complete interruption of the circulation for many minutes.

Cooling is best achieved by immersing the anæsthetised patient almost completely in a bath of ice-cold water so as to lower the internal temperature (as measured by intra-œsophageal leads) to below 30° C Alternatively the patient may be wrapped in tubed blankets through which ice-cold water circulates. Post operatively the temperature is allowed to rise slowly over a period of a few hours. A careful check must be kept on the cardiac rate and rhythm, the blood pressure and blood coagulability

It is possible that in the future further progress will be made by the use of oxygen under raised atmospheric pressure, so that during the period of cardiac arrest ischæmia of the vital organs may be prevented by increasing the solubility and partial pressure of oxygen in the plasma.

The *emergency treatment* of cardiac arrest occurring during or after operation is described on p. 9

CHAPTER 31

THE ABDOMINAL WALL AND HERNIA

INJURIES TO THE ABDOMEN

INJURIES to the abdomen include (1) open wounds caused by sharp weapons or high velocity projectiles, and (2) subcutaneous injuries caused by crush accidents or severe blows. Either type of violence may cause injuries limited to the parietes (abdominal wall, ribs, pelvis), or involve the abdominal viscera. In a blow by a blunt object it is often noted that if the blow is expected the abdominal muscles are held rigid and consequently bear the brunt of the injury; whereas, if it is not expected, they are relaxed and the unprotected viscera are more likely to be damaged

In the treatment of abdominal injuries, unlike thoracic injuries, operation *is often necessary* for the danger of missing a ruptured viscus far outweighs the small risk of laparotomy Indeed, operation should be advised as a routine whenever an intra abdominal lesion is *suspected and is imperative in every open wound of the abdomen,* however trivial it appears.

Subcutaneous Injuries of the Viscera. Injuries of this type occur when a patient is crushed or run over or struck a severe blow Such an injury may be accompanied by damage to the abdominal wall e.g fractured ribs, fractured pelvis, bruised abdominal wall but it is noteworthy that the abdominal wall may appear quite undamaged by an injury severe enough to cause rupture of a viscus.

Rupture of Solid Viscera. The viscera most liable to rupture are the spleen liver and kidney The cardinal feature is hæmorrhage, which does not come on at the time of the injury but after the initial shock has passed and the blood pressure has been restored. In rare cases the hæmorrhage is delayed for twenty four hours, or even several days.

In the case of the spleen and liver the hæmorrhage is intraperitoneal and is generally profuse. There are symptoms of acute loss of blood—restlessness, pallor dyspnœa, " air hunger rise of pulse rate—with signs of free fluid in the abdomen. The abdominal muscles are *boarded* and rigid, there are considerable abdominal pain and tenderness, and shifting dullness is present in the flanks.

The treatment is to operate at once. *If the spleen is ruptured* it should be removed if the liver it should be sutured or if this is im possible, the bleeding should be arrested by packing

In the case of the kidney the bleeding may be intraperitoneal, but more often it is extraperitoneal. It then gives rise to a swelling in the loin. Hæmaturia is a constant sign. The treatment is generally on expectant lines, but if the bleeding continues and becomes severe nephrectomy is indicated, provided the other kidney is present and healthy

Rarely the pancreas is injured and a retroperitoneal hæmatoma may result. It is generally believed that a small injury to the pancreas is responsible for the condition of *traumatic effusion into the lesser sac* which occasionally follows a subcutaneous injury to the abdomen A few weeks after the injury, a watery or bloodstained exudate appears in the lesser sac, sometimes containing pancreatic enzymes. The treatment is to open and drain the sac. To prevent digestion of the skin by the pancreatic enzymes sometimes present, an ointment containing 2 per cent. hydrochloric acid may be used or "Baltimore Paste which consists of 10 per cent. powdered aluminium in an ointment basis

Rupture of Hollow Viscera. Apart from the urinary bladder (p 400) the commonest site for an injury to a hollow viscus is the duodeno-jejunal flexure, where the mobile jejunum may be torn from the fixed duodenum. Rarely the stomach, ileum or colon is damaged Sometimes the intestine within a hernial sac is ruptured by a blow directly over the sac, while in rare cases the presence of an inguinal hernia has predisposed to rupture of the ileum, where it is held taut within the abdomen close to the mouth of the sac.

At the time of injury there is acute abdominal pain with nausea and vomiting Then a phase of reaction sets in, with improvement in the general condition. This phase is of short duration, however and within a few hours the symptoms of peritonitis appear just as in cases of open wounds of the intestines (see below)

On examination, the abdominal wall is not necessarily bruised, and may appear undamaged. Its respiratory movement is impaired, however and there are marked boarding and localised tenderness over the ruptured viscus. Percussion may demonstrate loss of liver dullness, owing to the presence of free gas in the peritoneal cavity while auscultation reveals entire cessation of peristalsis, due to reflex paralysis of the gut. Later if the case remains untreated, the signs of diffuse peritonitis appear

The diagnosis is to be made from a simple contusion of the abdominal wall. In the presence of multiple injuries, e.g fractured ribs, fractured spine or pelvis, it is very easy to overlook a visceral injury In a doubtful case the pulse, respiration and temperature should be taken every half hour and if there is no improvement within two or three hours the presence of a visceral injury should be presumed. The treatment is to open the abdomen, explore thoroughly and suture the damaged viscus. The possibility of multiple lesions should be borne in mind

Penetrating Wounds of the Abdomen. Penetrating wounds may be caused by a stab or gunshot wound or by impaling If the wound is limited to the abdominal wall it presents no special features, but if the abdominal cavity is entered there is a grave risk of damage to the viscera.

The common injury is perforation of the small intestine. Frequently, especially in gunshot wounds, there are multiple perforations At the time of injury the mucous membrane prolapses through the perforations

and occludes them, while reflex paralysis of the gut also militates against leakage, but these protective features are transient, and within a short time leakage of intestinal contents leads to fulminating peritonitis.

In some cases the abdominal viscera, especially the omentum and small intestine, prolapse through the wound in the abdominal wall.

The symptoms of a penetrating wound are somewhat variable. Generally at the time of the injury there is considerable shock, but this may pass off quickly and the general condition may improve to such an extent that the possibility of a severe injury is overlooked, until a few hours later, when the features of a fulminating peritonitis become manifest.

The treatment *is to operate in every case of wounded abdomen*, even though the wound appears to be of trivial nature. The wound is often valvular and it may be impossible to gauge its depth by inspection or probing In no case should time be lost in waiting for signs of rupture of a viscus, for when they appear it may be too late to avert a fatal peritonitis. At operation the superficial wound should be excised and followed to the peritoneum. The abdominal cavity is then explored and the intestines examined inch by inch, the possibility of multiple lesions being kept in mind Subsequently antitetanus serum and antibiotics should be given.

Viscera prolapsed through an abdominal wound should be wrapped in a clean towel until operation can be performed. They are then thoroughly cleansed with warm saline solution and returned to the peritoneal cavity *If this treatment is prompt and thorough the injury is* not necessarily fatal.

TUMOURS OF THE ABDOMINAL WALL

Such tumours as lipoma, fibroma or sarcoma may arise in the abdominal wall just as in other connective tissues.

Desmoid Tumour: Recurring Fibroma. This rare tumour occurs mainly in the abdominal wall It is a hard fibroma, characterised by a special tendency to recurrence. It owes its name "desmoid to its white, tendon-like appearance on cut section.

In most cases the tumour appears after an injury e.g a blow on the abdomen or the trauma associated with pregnancy and parturition. It generally arises in the lower part of the rectus muscle and forms a slowly growing tumour which infiltrates the muscle fibres and later may involve the parietal peritoneum the bony pelvis or the skin. It does not metastasise.

Clinically the tumour is recognised as a swelling in the lower part of the abdominal wall hard in consistence and indefinite in outline, at first with a limited mobility later infiltrating and fixed.

If possible the tumour should be removed along with a very wide margin of adjacent tissues, otherwise recurrence is probable It may be necessary to sacrifice much of the abdominal wall and carry out a plaster repair Radiotherapy is of little value.

AFFECTIONS OF THE UMBILICUS

Umbilical Calculus. This is a concretion composed of desquamated epithelium which gradually becomes inspissated and collects in a deeply recessed umbilicus. In the course of time the concretion may become large

and hard and cause pressure ulceration with discharge of bloodstained fluid. The resulting inflammatory mass may be mistaken for a malignant tumour The treatment is to dilate the orifice of the umbilicus sufficiently to permit extraction of the concretion, or to excise the whole mass including the umbilical cicatrix.

Fistula. A fistula at the umbilicus may occur as a congenital abnormality from persistence of the vitelline duct (which communicates with the small intestine) or rarely from persistence of the urachus (which communicates with the bladder) Or a fistula may be acquired, following intra-abdominal suppurations. In this latter category come biliary fistula, following an acute cholecystitis with abscess formation tracking along the ligamentum teres; fæcal fistula, following tuberculous or pneumococcal or other forms of peritonitis; and urinary fistula, following prevesical cellulitis All these fistulæ are rare

Lesions of the Vitelline Duct. The vitelline or vitello-intestinal duct is an embryonic channel connecting the small intestine with the yolk sac. Normally it is obliterated completely but in rare cases it persists in part or in its entirety Persistence of the whole length of the duct causes a fistula at the umbilicus, which discharges mucus or rarely fæces. Occasionally only the umbilical end remains patent, forming a small sinus and this may prolapse and appear at the umbilicus as a small cherry like mass covered with intestinal mucous membrane (entero-teratoma) Rarely an intermediate portion of the duct may persist and dilate, forming a cystic swelling immediately deep to the umbilicus (enterocystoma). The treatment of all these congenital lesions is by operative removal

The commonest lesion of the vitelline duct is the "Meckel's diverticulum" (p 405)

Lesions of the Urachus. The urachus is an embryonic channel connecting the urinary bladder with the allantois Rarely it remains patent and gives rise to a congenital urinary fistula at the umbilicus or it may be partly occluded at birth and open subsequently after low-grade suppuration along its track. Rarely an intermediate portion of the duct persists and dilates, forming a urachal cyst. Still more rarely a persisting portion of the urachus becomes the site of tumour formation.

Tumours of the Umbilicus. Primary tumours at the umbilicus include squamous epithelioma, melanoma and papilloma. They are to be distinguished from the more common secondary tumours, which include adenocarcinoma derived from the stomach or the rectum and endometrioma.

The treatment for a primary tumour is to excise it, with a sufficient margin of healthy tissue. An endometrioma may also be excised.

HERNIA

A hernia may be present at birth or develop at any stage of life. It usually develops at a site of congenital weakness, e.g the inguinal or femoral canal, or at the site of a wound.

It may give rise to no symptoms for a long time, but generally it causes pain, either locally or by pulling upon the mesentery, in the epigastrium.

On examination, there is a smooth, rounded swelling *which is soft*, elastic and resonant if the hernia contains intestine, or firmer if it contains omentum. A highly characteristic feature is the *impulse* on coughing

In the simplest cases the hernia appears only when the patient stands and disappears when he lies down. When the hernia is reduced,

whether spontaneously or by taxis, a gurgling sound is heard if intestine is present. After reduction, the opening through which the hernia has passed can be palpated; for example, a finger invaginated through the scrotal skin may be passed along the inguinal canal.

Principles of Treatment. Operative treatment carries a very low mortality, is highly effective, and gives a permanent cure in the great majority of cases. It should therefore be recommended in most cases unless clearly contra indicated. Treatment by truss is never curative, often inefficient and always troublesome, and should only be recommended if operation is out of the question.

The aims of operation are to expose and remove the hernial sac, returning any contents to the abdominal cavity, and to repair the defect in the abdominal wall.

Operation is contra indicated (1) in infants, for spontaneous cure of the hernia is common during the first few months of life (2) in aged, bedridden or debilitated persons (3) in the presence of chronic bronchitis or conditions causing difficulty in micturition or defæcation, which would predispose to recurrence of the hernia (4) if technical difficulties, e.g a very large sac or a very weak abdominal wall, render successful cure unlikely

To reduce a hernia by taxis the patient should be placed with the foot of the bed raised and hips and knees flexed in order to relax the abdominal wall. The neck of the hernia is then steadied with one hand, while the other is used to replace the contents into the abdomen. If the hernia is large, the intestines nearest to the neck of the sac should be reduced first, and later those more distant.

Irreducible Hernia

In many cases the hernia cannot be reduced, owing either to the size of the contents or to adhesions between them and the sac wall. Mere irreducibility may cause no added symptoms, though often there is rather more pain, but there is an added risk of such complications as obstruction and strangulation. For this reason operative treatment is highly desirable. If operation cannot be carried out an ordinary truss is useless, but a special truss with a bag to support the hernial sac may be worn

Obstructed (Incarcerated) Hernia

This is the term applied when the passage of intestinal contents is obstructed, but the blood supply of the herniated loop is unaffected Often, however an obstructed hernia becomes strangulated if left untreated and indeed many surgeons believe that incarceration invariably leads to strangulation unless promptly treated

Simple obstruction occurs most often in an umbilical hernia, and is generally due to fæcal impaction in adherent coils of large intestine within the sac. The treatment is to give copious enemata of soap and water If these fail to give speedy relief operation is indicated.

Strangulated Hernia

In a strangulated hernia the intestine is obstructed and, in addition its blood supply is impaired Nearly always the strangulating agent is the abdominal wall at the point of emergence of the hernia, e.g the subcutaneous ring in an inguinal hernia, or Gimbernat's lacunar ligament in a femoral hernia. Often the strangulation occurs when a loop of intestine or portion of omentum is suddenly forced into the sac during a bout of coughing or a sudden straining at stool

The venous blood flow is impaired first, and the affected loop of intestine becomes turgid purplish in colour and intensely congested while its mucosa becomes hæmorrhagic and blood is effused into the lumen. Later the arterial circulation is also impeded, and gangrene of the intestinal wall results The gangrene appears first at the constriction rings, where the intestine is compressed by the neck of the sac. At these rings the intestine is deeply grooved and of pale grey colour Later the whole loop becomes necrotic, and becomes pale opaque, flabby and sodden like wet blotting paper

Clinical Features. The clinical features of strangulated hernia are characteristic. There is a sudden sensation of intense discomfort in the hernia, and this is succeeded by colicky pains, generalised over the abdomen The pains recur at frequent intervals and there is repeated vomiting first of stomach contents, then of bilious fluid, and finally of foul-smelling brown fæculent intestinal matter The bowels may move once or twice after the onset of strangulation the content of the colon below the obstruction being evacuated but after that they are completely closed and, despite enemata, neither fæces nor flatus is passed (except in a Richter s hernia—see below)

On examination, the hernia is tense and often a little tender The patient may volunteer that it is larger and more tense than previously It is of course, irreducible.

In addition, there are the signs of intestinal obstruction The tongue is dry and furred and in the late stages the face is pale and drawn. The pulse rate is increased, the temperature may be subnormal or slightly raised. The abdomen is somewhat distended, and visible peristalsis may be present, though rarely

Treatment. A strangulated hernia must be treated by prompt operation, preferably under spinal or local anæsthesia. Before operation the stomach should be washed out to prevent inhalation of vomit during the induction of anæsthesia. The dehydration should be overcome by copious intravenous fluids. Taxis should not be attempted except in the early stages, for the devitalised intestine may be ruptured. In addition, there is the risk, though slight, of reducing the hernia *en bloc* complete with its sac, without relieving the strangulation.

In the operation the hernia is exposed, the sac opened and the constricting agent divided. Adhesions are then separated and any omentum present may be returned to the abdomen, or if too bulky or infected it may be ligated and removed. The intestine must be

examined carefully to estimate its viability, and drawn down an inch or two to permit careful inspection of the constriction rings. If the intestine glistens and undergoes active contraction, it is certainly viable and may be returned to the abdomen with safety If it does not contract, and especially if it is pale, soft and flabby, it should be regarded as non viable. In such a case, and indeed whenever there is the slightest doubt as to the viability the preferable line of treatment is to remove the affected segment, restore the continuity of the intestine by anastomosis, and then proceed as for a simple hernia.

The after treatment should include gastric lavage and administration of fluids as for intestinal obstruction (p 409)

Richter's Hernia. This is a strangulated hernia in which only a part of the circumference of the bowl is involved It occurs most often in a femoral hernia, and indeed, is the commonest type of strangulated femoral hernia.

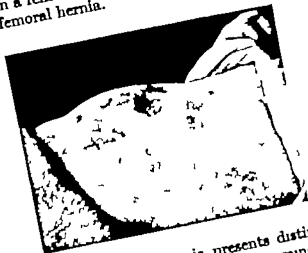


FIG. 199. Visible peristalsis in a woman who for a week had suffered from repeated vomiting and colicky abdominal pain. The bowels had been opened during the first two days only The obstruction was due to a femoral hernia of the Richter type.

A Richter's hernia presents distinctive features. There are acute colicky pains with vomiting becoming progressively more stercoraceous in character but the bowels at first continue open, and thus the condition may not be recognised as one of intestinal obstruction. Indeed, if the small swelling in the groin is not noticed the diagnosis may easily be missed. Later when the obstruction becomes complete, the diagnosis is clear but by this time the general condition may be critical. This emphasises the importance, in all obscure abdominal conditions, of examining the hernial apertures.

Strangulated Omental Hernia. A portion of omentum strangulated in a hernial sac may cause symptoms similar to though less severe than those of an intestinal strangulation. There is the same sudden pain in the hernia, followed by recurring epigastric pain and a little vomiting and by partial obstruction of the bowels. Generally however enemata yield satisfactory results and the symptoms abate after a few days The treatment is as for a simple hernia. The strangulated portion of omentum should be removed

Hydrocele of Hernial Sac. When a portion of omentum becomes partially strangulated within a hernial sac and adheres to it in such a way as to occlude the neck, the sac may distend with watery fluid. Such a hydrocele of a hernial sac forms a smooth, tense, elastic, painless swelling which may be mistaken for a simple hydrocele The treatment is by operation.

OBLIQUE INGUINAL HERNIA

This is by far the commonest type of hernia It affects men far more often than women, and generally appears in early adult life though it is not uncommon in infancy Often there is a history of a strain or injury which may have predisposed to the herniation

The hernial sac escapes from the abdomen through the internal ring passes along the inguinal canal and emerges through the external



Fig. 200. Right oblique inguinal hernia of three months duration in a man aged 44



Fig. 201 Method of palpating the subcutaneous ring by the forefinger invaginating the scrotal skin.

ring Throughout its course it lies immediately in front of the vas deferens, within the coverings of the spermatic cord. The inferior epigastric artery lies medial to the neck of the sac.

The hernia may reach only as far as the external ring and may then be termed a "bubonocele" (bubo a swelling in the groin) or it may extend down the spermatic cord to the scrotum (scrotal hernia) In the female it lies within the canal of Nuck and may extend into the labium majus (labial hernia)

The peritoneal sac of the hernia may be an acquired one, the

peritoneum being forced as a diverticulum along the inguinal canal. Often, however the sac is congenital, due to persistence of the processus vaginalis, the sleeve of peritoneum carried down to the scrotum during descent of the testis. All inguinal hernias in infants have such a congenital sac, and also many hernias appearing first in adult life.

Sometimes the whole length of the processus vaginalis remains patent, and then the herniated intestine passes directly into the tunica vaginalis in front of the testis. More often the processus is obliterated for a short distance immediately above the level of the testis, so that *the hernial sac does not communicate with the tunica vaginalis* According to the precise relations of the sac, various confusing names (congenital, infantile, vaginal, etc.) may be applied but they are of no practical importance.

Clinical Examination. When a suspected case of hernia is examined the following routine should be adopted —

First the patient should be examined standing with both groins fully exposed Any swelling present is then inspected, and its size, shape and situation noted It is then palpated, and its consistency weight and tenseness estimated. The patient is then instructed to cough while the swelling (and the whole inguinal region) is first inspected and then palpated to determine if an impulse is transmitted. If large enough, the swelling is now percussed to determine whether tympanitic or dull, and is subjected to the transillumination test *to exclude hydrocele.* At this stage the opportunity should also be taken to examine both testes, epididymes and spermatic cords. The femoral region should also be examined, *for a femoral hernia may co-exist.*

Next the patient should be placed supine, with the knees drawn up and if the swelling does not disappear spontaneously an attempt should be made to reduce it by taxis. When this has been done the finger should be invaginated through the scrotal skin to feel the subcutaneous ring (Fig 201) Normally the canal will barely admit the tip of a small finger

Diagnosis. An oblique inguinal hernia, in addition to being the commonest swelling in the groin is also one of the easiest to diagnose. If there is a swelling which appears on standing, is reduced on lying down, and gives an *impulse on coughing, if* it lies above and medial to the pubic tubercle, and if the inguinal canal is dilated and the invaginated finger can feel the cough impulse the diagnosis is certain. An irreducible hernia containing omentum is less typical, but even here there is rarely any serious difficulty

In the case of a small hernia the diagnosis must be made from direct inguinal hernia, femoral hernia, undescended testis, hydrocele of the cord, and from a lymph gland, a simple tumour (e.g lipoma) *or a* cold abscess in the groin.

A scrotal hernia must be diagnosed from hydrocele, cyst of the epididymis *and enlargements of the testis.*

A labial hernia must be diagnosed from a tumour or cyst of the labium majus.

Treatment. Except in infants radical treatment by operative measures should always be advised unless clearly contra indicated (p 360) In infants of three months or less a natural cure may sometimes occur No treatment is necessary at this stage but if desired the hernia can be controlled by a simple truss, most satisfactorily made of a skein of wool The skein is held with one looped end over the affected groin The other end is then carried round the pelvis, through the loop and

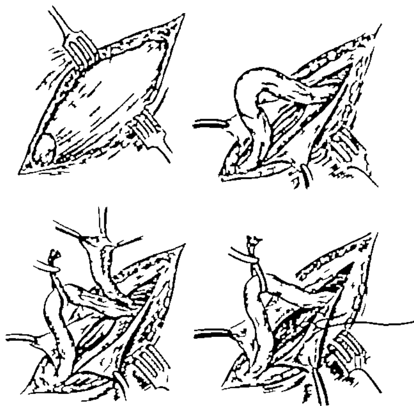


FIG 202. Bassini operation for oblique inguinal hernia. (a) Skin incised; external ring seen line of incision in aponeurosis indicated. (b) Canal opened; cord mobilised. (c) Coverings of cord incised. Sac displayed, opened and twisted ready for transfixion stitch. (d) Sac removed (not shown) conjoint tendon being stitched to deep aspect of inguinal ligament.

then down to the perineum and round to the back, where it is tied. In adults, if operation is contra indicated, a truss should be worn. A spiral spring steel truss with an adder head bearing on the inguinal canal suffices for most cases If it tends to slip, a rat tail truss with a perineal band may be fitted An irreducible hernia cannot be controlled by a truss, but some relief may be obtained if the weight of the hernia is supported by a so-called bag truss.

In children the operation consists in exposing the spermatic cord at the external ring and removing the hernial sac. In adults the cord must be followed up to the internal ring (this necessitates opening the canal by splitting the fibres of the external oblique aponeurosis) and after it has been removed the posterior wall of the canal must be reinforced

Innumerable methods have been devised for this purpose. Most of them are variants of the Bassini procedure, in which the conjoint muscles (internal oblique and transversus) are sutured, either behind the spermatic cord or in front of it, down to the deep surface of the inguinal ligament. The suture material may be catgut, linen, silk, nylon, or fascia. If the defect is large, a flap from the rectus sheath may be turned down, or a filigree of tantalum wire introduced

DIRECT INGUINAL HERNIA

This hernia is always an acquired one, and occurs mainly in elderly men. The hernia escapes from the abdomen through the posterior wall of the inguinal canal either through a defect in the conjoined tendon or by bulging the thin atrophic tendon in front of it. The hernia then lies *directly behind the cord and bulges directly forwards through the* external ring



FIG 203. Bilateral inguinal hernia of many years' duration in a man aged 45. On the right side there was a sliding hernia containing *cæcum and appendix.*

The clinical features are similar to those of an oblique hernia, from which it may be distinguished by its more direct course.

The treatment is by operation unless there is any clear contra indication At operation the inguinal canal is opened and the hernial sac defined as it lies *medial to the inferior epigastric artery* and behind and separate from the spermatic cord If the sac is a mere bulging of the peritoneum it may be left untouched, if it has a definite neck it should be dissected up ligated and removed. The abdominal wall is then strengthened by one of the methods described above.

SLIDING HERNIA

This is the term applied to either an oblique or a direct inguinal hernia in which extraperitoneal structures slide down with the peritoneal sac. Thus on the right side the cæcum and ascending colon may be found in the inguinal canal, lying behind the peritoneal sac on the left side the iliac colon may occupy a similar position, while on either side a portion of the bladder may be closely related to the neck of the sac.

The clinical features are those of a large, irreducible hernia. Its sliding character can only be determined by radiography after barium, which demonstrates the cæcum or iliac colon in the sac.

At operation it is important to recognise the extraperitoneal viscus and to avoid damaging its blood supply After careful dissection the peritoneal sac should be excised and the peritoneum closed The extraperitoneal viscus is then returned to the abdomen, and the canal strengthened in the usual way

FEMORAL HERNIA

A femoral hernia escapes from the abdomen by passing down through the funnel-shaped femoral canal deep to the medial part of the inguinal ligament. In this part of its course it lies in front of the pubis and the pectineus muscle and fascia, with Gimbernat's lacunar ligament on its medial side and the femoral vein on its lateral side.

Reaching the lower end of the femoral canal, the hernia turns forwards and projects through the fossa ovalis, displacing the cribriform fascia in front of it. A large hernia finally may turn upwards in the subcutaneous tissue, so that its tip comes to lie in front of the inguinal ligament.

A femoral hernia occurs mainly in women, doubtless owing to the larger size of the femoral canal in the broad female pelvis. There is no preformed sac, except possibly in rare cases.

Clinical Features. The hernia is most common in women over 40 It may cause no symptoms or give rise to pain in the groin, referred pain in the epigastrium and indigestion

Examination reveals a swelling in the groin often no bigger than a cherry It may be so small and so free from symptoms as to have been unnoticed When the hernia is large it passes upwards over the inguinal ligament, but its neck can always be felt to be below and lateral to the pubic tubercle, and thus serves to distinguish it from an inguinal hernia. The hernia is best reduced by pressure in a slightly downwards direction, and it then disappears deeply into the fossa ovalis.

Often, however the hernia contains adherent omentum, and is irreducible. In such cases the cough impulse is difficult to detect.

Diagnosis. The diagnosis is to be made from inguinal hernia, a lymph gland, a simple tumour e.g fibroma, a cold abscess, and a dilated pouch of the great saphenous vein. Generally there is no difficulty for all these lesions except inguinal hernia are rare.

Femoral hernia may be diagnosed from inguinal hernia by its position (below the inguinal ligament and infero-lateral to the pubic spine, whereas inguinal hernia is above and medial) by the fact that it reduces in a slightly downwards direction whereas inguinal hernia reduces upwards and laterally and by the fact that after reduction the finger



FIG. 204. Right femoral hernia in a woman aged 74 who had had symptoms of partial intestinal obstruction for five days. At operation a knuckle of ileum was completely gangrenous.

cannot be inserted in the inguinal canal or being inserted does not prevent the hernia from being extruded on coughing

Treatment. Operation should be advised in almost every case, owing to the grave risk of strangulation. If operation is contra indicated a truss may be worn but often a truss is painful and inefficient.

At operation the sac is exposed by a vertical or oblique incision and defined by dissection This is difficult if the sac is filled with adherent omentum. Next the external oblique aponeurosis is incised laterally from the external ring and the dissection is deepened above the inguinal ligament to demonstrate the neck of the sac as it enters the femoral canal. Alternatively access to the upper end of the canal may be gained through a paramedian incision deepened through the rectus sheath into the extraperitoneal space. The contents of the sac are then reduced, and the sac itself is displaced upwards through the canal and presented above the inguinal ligament. The sac is then excised or bunched up by a suture. The next step is to repair the



FIG. 205. Saphenous pouch associated with varicose veins in leg

opening in the femoral canal This is best done by lacing a fascial graft, conveniently obtained from the external oblique aponeurosis, between the anterior and posterior margins of the femoral canal—the inguinal ligament and the periosteum of the pubis

Complication. A femoral hernia is very liable to strangulation, especially to strangulation of a knuckle of the small intestine (Richter's hernia) When this occurs there may be no symptoms referable to the hernia, and if small it may be unnoticed, or its significance unrecognised In a strangulated Richter's hernia the symptoms are recurring colicky abdominal pains with vomiting of stomach contents, bilious fluid, and eventually brown stercoraceous matter The lower abdomen becomes distended and peristaltic waves may be visible. The symptoms are thus typical of intestinal obstruction, except that the bowels may continue to move for two or three days (see also p 308)

UMBILICAL HERNIA

Congenital Umbilical Hernia (Exomphalos) During early intra uterine life the intestines are displaced as a "physiological hernia" into the umbilical cord Normally they should return to the abdomen at about the tenth week of intra uterine life, but in rare cases they retain their abnormal situation At birth there may be a small hernia or a large one involving the greater part of the midgut. The umbilical orifice may be greatly dilated, and the intestines may be visible through the thin membranes of the umbilical cord

If the hernia is small it may be reduced and the cord ligated in the usual way and divided The hernia then usually undergoes spontaneous cure. If the hernia is large, immediate operation is advisable to avert rupture of the sac and prolapse of the viscera. The sac is opened the contents returned to the abdomen and the orifice closed by sutures.

Umbilical Hernia in Infants. An umbilical hernia may develop during the first few months after birth along a preformed sac, due to failure of normal obliteration of the umbilicus. The hernia presents as a soft, round easily reducible swelling There is a pronounced tendency towards spontaneous cure.

The traditional treatment is to wrap a penny in gauze and fix it over the umbilicus by strapping If the hernia persists after a few months, it may be cured by inserting a subcutaneous suture as a purse-string round the neck of the sac.

Umbilical Hernia in Adults. Umbilical hernia develops commonly in middle-aged, obese women, especially multiparous. The hernia protrudes through a rounded defect in the linea alba, either at or immediately above the umbilical cicatrix. It enlarges gradually especially if the obesity increases, and eventually may become very large and hang pendulous in front of the pubes.

The sac contains omentum, transverse colon and occasionally small intestine. Generally the hernia is irreducible, owing to extensive

adhesions between the sac and its contents. The overlying skin becomes stretched and thin, and is very liable to dermatitis

In many cases the hernia gives rise to recurring symptoms from partial obstruction of the transverse colon, with colicky abdominal pains, marked constipation and some vomiting Acute obstruction (incarceration) and strangulation are common complications

The treatment is by operation if the general condition permits. If operation is contra indicated, a belt should be fitted to control the hernia or to support the protrusion. Often, however a belt is un satisfactory, and it entirely fails to reduce the risk of strangulation, since the adhesions are unaffected

At operation a transverse incision is made, with an ellipse outlining the skin overlying the sac. The neck of the sac is then defined as it emerges through the defect in the linea alba, the sac is opened, adhesions are divided, the omentum is resected and the viscera are returned to the abdomen, and finally the defect is repaired by overlapping its upper and lower margins.

In strangulated umbilical hernia a similar operation should be performed if the general condition permits. If the condition is critical, the sac may be opened under local anæsthesia and the strangulating band divided, with no attempt at radical cure.

EPIGASTRIC HERNIA

This is a hernia of extraperitoneal fat, sometimes with a small peritoneal sac contained in it, which is extruded through a small rounded defect close to the midline of the linea alba 2 or 3 inches above the umbilicus. It presents a small lump under the skin, which at first resembles a lipoma, but later may become fibrous and indurated owing to partial strangulation of the fat.

The hernia generally occurs in young adult males. It may be symptomless or give rise to upper abdominal pain and dyspepsia.

The treatment is to excise the fat and the peritoneal sac and to repair the defect in the linea alba.

INCISIONAL HERNIA

A hernia may develop through the thinned-out scar of an operation wound, especially one through the lower abdominal wall, where the pressure of the viscera is greater than in the upper abdomen. Severe coughing during the post-operative period predisposes to herniation, as does wound sepsis, for the wound heals by fibrous and the resultant scar is often thin and liable to stretch.

Often the greater part of the operation wound gives way and the hernia presents an extensive bulging through one or more large defects in the abdominal wall. The hernia generally contains adherent intestines and is covered by thin adherent skin.

The treatment is to expose the hernia through an elliptical incision,

excising the old scar The intestines are separated from the sac and returned to the abdomen, the peritoneum is closed, and the abdominal wall closed in layers. If the defect is large, fascial sutures should be used

OBTURATOR HERNIA

This is a rare hernia in which the sac escapes along the path of the obturator nerve and vessels through the canal in the upper medial part of the obturator foramen The sac thus reaches the upper part of the thigh where it lies deeply placed under cover of the pectineus and adductor brevis muscles

The hernia may give rise to pain on the medial aspect of the thigh specially on rotation of the limb It is very liable to strangulation. There is rarely any palpable swelling and in most cases the condition is only recognised when the abdomen is opened for acute obstruction

INTERNAL HERNIA

This is a hernia of small intestine through some developmental or pathological aperture within the abdominal cavity

Developmental apertures include the paraduodenal and ileocæcal fossæ, congenital apertures in the mesentery and snares formed by a Meckel's diverticulum. Pathological apertures, which are more frequent, are most often caused by post-operative adhesions.

All forms of internal hernia are very liable to strangulation. They give rise to no characteristic symptoms except those of intestinal obstruction and their exact nature can rarely be diagnosed until the abdomen is opened. At operation the herniated loop is found greatly distended, purplish in colour or frankly necrotic. In attempting to reduce the hernia special attention must be paid to the constricting band which may contain an important blood vessel, such as the inferior mesenteric vein (see below)

Duodenal Hernia is a term applied to hernia of the small intestine into one of the congenital peritoneal pouches related to the duodenum. The commonest is the paraduodenal fossa, a retroperitoneal pouch which is directed upwards and to the left, under cover of the inferior mesenteric vein, immediately to the left of the terminal part of the duodenum. The vein comes to lie near the margin of the anterior lip of the orifice of the pouch, and must be carefully avoided when the hernia is being reduced.

Less often a hernia takes place into a pouch which passes to the left behind the superior mesenteric artery immediately below the third part of the duodenum. In this case the artery is in some danger when the hernia is being reduced.

Pericæcal Hernia takes place into one of the retro-peritoneal pouches related to the cæcum, especially the ileo-appendicular which lies between the bloodless fold of Treves and the meso-appendix, and the retrocolic, which lies behind the cæcum and ascending colon.

Intersigmoid Hernia is a rare hernia into the intersigmoid fossa, a retroperitoneal pouch which passes behind the sigmoid vessels in the angle between the two limbs of the sigmoid colon

Hernia into the Foramen of Winslow is a very rare form of internal hernia. When obstructed, the intestines incarcerated in the lesser peritoneal sac form a tympanitic swelling in the epigastrium.

Hernia through the Mesentery is very rare. It occurs through a congenital aperture in the mesentery Reduction may be difficult, and special care is necessary to avoid damage to the mesenteric vessels

DIAPHRAGMATIC HERNIA

There are two principal types.

Hernia through a Pleuro-peritoneal Defect. The rare congenital defect is usually situated in the posterior part of the diaphragm on the left side, at the site of the embryonic pleuro-peritoneal aperture. It varies enormously in its effects in some cases the child is stillborn, in others the lesion causes no symptoms until late childhood or even adult life.

There is a free communication between peritoneal and pleural cavities, and usually small intestine, part of the colon and often the spleen lie within the chest. The left lung is collapsed In some cases there is dyspnœa due to pressure on the lung and heart. In others there are attacks of pain and vomiting due to incarceration or obstruction of the intestines.

The diagnosis may be made on auscultatory evidence of bowel sounds within the thorax, and is readily confirmed on X ray examination The treatment is to open the thorax by an incision through one of the lower intercostal spaces, to restore the intestines to the abdomen, and to repair the defect in the diaphragm. A fascia graft may be required for this last purpose.

Para-œsophageal Hernia Hiatus Hernia. Hernia through an enlarged œsophageal hiatus is usually seen in elderly people, especially stout women, though occasional examples occur in childhood Through the gap a pouch of stomach of variable size ascends into the mediastinum. In some cases, the rolling type, the œsophagus retains its normal position, the cardiac end of the stomach remains at its proper level and the fundus rolls into the thorax. In others, the sliding type, the œsophagus becomes shortened and the whole of the proximal part of the stomach slides upwards into the mediastinum. The size of the pouch may vary from a mere knuckle to half the stomach.

There may be no symptoms, but often, and especially in the sliding type, the reflux of acid juice leads to œsophagitis or peptic ulcer of the œsophagus (p 380)

CHAPTER 32

THE PERITONEUM

ACUTE PERITONITIS

ACUTE peritonitis is nearly always due to injury or disease of the abdominal viscera. The common causes are appendicitis, perforated peptic ulcer gangrene of the bowel due to obstruction strangulation leakage from carcinoma of the colon. The infection is generally a mixed one with *B coli* preponderating

The affected peritoneal surfaces become highly congested, lose their glistening appearance, and are covered with adherent flakes of lymph. A peritoneal exudate develops, sero-sanguinous in streptococcal infections, purulent in other types, foul-smelling in mixed infections from the intestines Owing to the action of toxins on the muscle fibres or on Auerbach s plexus, the intestine in the affected area is paralysed and distends with gas. The intestinal paralysis, together with the rigidity of the abdominal wall, serve to immobilise the inflamed surfaces and to diminish spread of the infection

In mild cases the infection becomes circumscribed by peritoneal adhesions or by the action of that abdominal policeman " the great omentum, which wraps itself round any focus of disease within its reach. This localised form of peritonitis may resolve or may progress to abscess formation, especially in the pelvis (p 473) or in the subphrenic space (p 382) In severe cases, on the other hand, the infection spreads widely and a diffuse peritonitis results

Localised Peritonitis. The clinical features of localised peritonitis supervene upon and are merged with those of the causative lesion, e g appendicitis (p 469) There is pain referred to the affected area, with localised rigidity tenderness on pressure and perhaps hyperaesthesia. The affected part is somewhat distended and does not move on respiration Later if an abscess forms, a tense tender swelling becomes evident. In contrast to diffuse peritonitis, the unaffected part of the abdomen remains soft and flaccid.

Diffuse Peritonitis. The symptoms and signs of diffuse peritonitis are those of a rapidly spreading intense infection with severe toxaemia and dehydration. The picture is very similar to that of paralytic ileus (p 411)

Pain is generally the first symptom, except in post-operative peritonitis, when it may be lacking The pain often arises suddenly especially when due to a perforative lesion. It is of burning character continuous and severe, starting over the site of the causative lesion and spreading thence across the abdomen.

Vomiting occurs early At first the vomit is of gastric contents or

bile, later it is of dark, offensive intestinal fluid. The vomit is effortless and frequently repeated.

The bowels in most cases are obstinately constipated, and little or no flatus is passed. In the early stages of pelvic peritonitis, however there may be diarrhœa, due to irritation of the lower bowel.

The general appearance indicates the profound toxæmia and dehydration. The patient looks anxious, with drawn features, hollow-eyed, and in the later stages his colour is ashen, with cyanosis due to failing circulation. He lies with his knees drawn up to relax the abdominal wall. The tongue is furred and dry

The temperature at first is raised, perhaps to 100° or 102° F later it is subnormal. The pulse becomes increasingly rapid and later small and thready Respiration is of thoracic type and is shallow and rapid.

The abdomen is full, uniformly distended and tympanitic, owing to gaseous dilatation of the intestines. It does not move on respiration. The muscles of the abdominal wall are held rigid. There is marked tenderness on pressure on all parts of the abdomen. Finally, no peristalsis is evident and no bowel sounds are heard on auscultation with a stethoscope

Diagnosis The diagnosis is to be made from intestinal obstruction, which at a late stage may bear a close resemblance. In obstruction, however the pain is colicky and generally there is little tenderness on pressure. In addition, the stethoscope will reveal frequent bowel noises in obstruction, none in peritonitis.

In most cases the presence of peritonitis is easily diagnosed. The important step however is to diagnose the cause of the peritonitis, and this may be less simple.

In a person with a recent history of acute abdominal pain, such diseases as appendicitis, perforated ulcer volvulus, etc., should first be considered. In an old person diverticulitis or a leaking carcinoma of the colon should be borne in mind. In women with pelvic peritonitis an infection of the genital passages should be sought.

Treatment. Operation is indicated if the cause of the peritonitis is remediable, e.g in the great majority of cases of appendicitis, perforation, obstruction and similar abdominal lesions. Exceptions to this rule are discussed in the relevant sections.

In all forms of peritonitis the treatment has been vastly improved by modern methods, of which the general principles are to combat the infection, to keep the stomach empty and to control the fluid and electrolyte balance.

A wide-spectrum antibiotic should be used. The stomach should be kept empty by continuous drainage through a 7 mm. nasal catheter Ringer's solution with glucose should be given intravenously in large amounts, and potassium replacement solution may be required at intervals (p 5)

The patient should be nursed in a comfortable position with the head raised on pillows Formerly much stress was placed on propping him

in the "Fowler" position to let infective fluid gravitate from the subphrenic space towards the pelvis

The bowels should be kept completely at rest for a week or more to aid limitation of the infection For this reason no aperient must be given, nor should such drugs as pituitrin or eserine be used (This is directly at variance with the older teaching to get the bowels opened at any cost"; often the cost was the patient's life)

Under adequate treatment unless there has been a very heavy contamination the peritonitis settles in a few days the temperature comes down the general conditions improves, the abdomen becomes less rigid and less distended The gastric suction tube at first yields copious brown jejunal fluid later as normal peristalsis returns the drainage becomes yellow or green with bile and smaller in amount. At this stage a small enema may be given with safety

After severe peritoneal contamination although the infection as a whole is overcome there is a risk that loculated abscesses may form, especially in the subphrenic space or in the pelvis.

TUBERCULOUS PERITONITIS

The peritoneum may be infected from a tuberculous mesenteric gland a tuberculous ulcer of the ileum or a tuberculous Fallopian tube. In most cases the peritoneum is involved diffusely Innumerable minute tubercles cover the



FIG. 206. Tuberculous peritonitis in a boy aged 15, who for five months had suffered from wasting and abdominal distension, with recent vomiting. The peritoneum was studded with innumerable tubercles and the cavity contained sero-purulent fluid. Note the marked wasting.

peritoneal surfaces, and *straw-coloured turbid fluid* is exuded into the cavity In the more chronic cases at a later stage the fluid is absorbed and extensive adhesions form between the diseased surfaces

The disease may take an acute course, with pyrexia and marked wasting, or it may progress slowly with *abdominal distension* ascites and recurrent partial obstruction The treatment is on conservative lines.

TUBERCULOUS MESENTERIC GLANDS

Tubercle bacilli swallowed in infected milk or sputum gain entrance to the tissues most readily through the Peyer's patches of the lower ileum and

are carried thence directly to the regional lymph glands in the mesentery and ileo-cæcal region

The frequency of this disease in the past is attested by the number of calcified glands seen on routine examination in adults. Now they are becoming rare. They cause obscure ill health and vague abdominal pains but respond well to conservative treatment

RETROPERITONEAL TUMOURS AND CYSTS

Apart from tumours and cysts arising from such retroperitoneal organs as the kidney and pancreas there are a number which grow unattached in the retroperitoneal tissues. The tumours include lipoma, fibroma, sarcoma, *neuroblastoma*. The cysts include blood cysts resulting from trauma, hydatid cysts and rare developmental cysts believed to arise from the Wolffian body or other embryonic tissues

The symptoms are insidious in onset and not characteristic. There is vague pain diffused over the abdomen accompanied by attacks of vomiting. The bowels are constipated and subacute obstruction may be caused by the pressure of the mass. Abdominal examination reveals a deeply placed swelling generally smooth rounded and painless. The swelling does not move on respiration nor can it be displaced manually. *Coils of intestine* spread over its surface render it tympanitic.

The diagnosis is to be made from lesions of the kidney and pancreas from glandular enlargements (lymphadenoma, secondary carcinoma), from cystic dilatation of the lesser sac, and from localised tuberculous peritonitis. Radiography is of value: a barium meal shows the stomach or intestines displaced forwards and spread over the rounded surface of the mass and pyelography may show the ureter (which adheres to the parietal peritoneum) displaced and compressed.

The diagnosis is to be confirmed by laparotomy and in some cases the tumour or cyst can be shelled out.

MESENTERIC TUMOURS AND CYSTS

These rare lesions are similar in pathological character to those of the retroperitoneal tissues. They give rise to a smooth rounded mass, often of considerable size which displaces the intestine over it and may lead to subacute obstruction. The lump is generally situated towards the middle of the abdomen, and it possesses a limited mobility. Its situation may be demonstrated by radiography after a barium meal. The treatment is to remove the tumour by operation. In some cases the overlying loop of intestine must also be removed.

PSEUDO-MYXOMA PERITONEI

This rare condition is characterised by the formation of masses of mucoid material in the peritoneal cavity. In most cases it is due to dissemination of mucus-secreting cells from a ruptured pseudo-mucinous cyst of the ovary. Rarely it follows rupture of a mucocele of the appendix.

The mucoid material, which may be limited to one part or diffused throughout the peritoneal cavity causes an inflammatory reaction and leads to marked thickening of the peritoneal surfaces. There is generally ill-defined *abdominal* pain with distension and soft irregular masses may be palpable. The treatment is to remove the cause. In some cases when this has been done the mucoid material is gradually organised and absorbed.

SUBPHRENIC ABSCESS

This dangerous disease nearly always follows a suppurative process within the abdomen, especially appendicitis, perforated ulcer or an

infection of the biliary tract. Rarely it results from a blood borne infection from the throat or a distant suppuration Streptococci and coliform bacilli are generally responsible, either alone or together

Anatomical Features. The subphrenic region has been divided, rather artificially, into six anatomical regions. In practice the great majority of subphrenic abscesses occur on the right side, either in that part of the general peritoneal cavity which lies above the liver to the right of the ligamentum teres, or in the extraperitoneal tissues corresponding to the ' bare area.

Clinical Features. A subphrenic abscess generally appears one to three weeks after the onset of the causative infection It arises insidiously and enlarges gradually until eventually it may contain several ounces of thick pus, often foul smelling Since most of the causative lesions are on the right side of the abdomen the abscess also is most often right-sided

The first signs are those caused by any suppurative process. The early improvement after the causative infection has subsided (or after operation) is not maintained the appetite is lost, the patient feels weaker the tongue is coated and the temperature raised Later these signs increase in severity, the temperature becomes remittent, the pulse rate is increased there are marked sweating and rapid loss of flesh. The leucocyte count is greatly raised, with a high proportion of immature polymorphs.

At this stage it is clear that suppuration is in progress, but the site of the abscess is in doubt, and perhaps the possibility is raised of a pelvic abscess or an abscess in the operation area.

Later localising features develop There are pain over the lower ribs and sometimes deep tenderness on pressure, or even slight fullness of the soft tissues. The liver is displaced downwards. Percussion reveals dullness at the base of the lung due partly to elevation of the diaphragm, partly to pleural fluid and patchy consolidation of the lower lobe. Crepitations may be audible.

Diagnosis The diagnosis is confirmed by X rays Under the screen the affected half of the diaphragm is seen to be immobile and is elevated, so that the costo-phrenic sinus is obliterated. Occasionally gas is visible in the abscess, escaped from a hollow viscus or formed by fermentation.

The final diagnosis is made by aspiration through a hollow needle. This test should be delayed until the patient is prepared for operation, lest pus leak along the needle track and infect the pleura.

Treatment. In most cases the abscess is best opened by the posterior route. The last rib is resected, with care to avoid injury to the pleura. The incision is deepened through the posterior part of the diaphragm below the pleural reflection, and blunt dissection is extended upwards deep to the diaphragm until the abscess is opened.

If the abscess is situated anteriorly it can be opened most conveniently through an incision below the rib margin in front.

CHAPTER 33

ABDOMINAL EMERGENCIES

THE various diseases grouped under the slovenly though descriptive term "Acute Abdomen" constitute a subject of immense importance, both to surgeons and to practitioners, for in no other field is the importance of early diagnosis and prompt treatment so vital. In such common diseases as perforated ulcer and intestinal obstruction every hour wasted increases the danger to life, while even in appendicitis a few hours' delay may add greatly to the gravity of the prognosis.

The following are the more important surgical lesions:—

(1) In new born infants. Developmental abnormalities such as duodenal stenosis, volvulus of the mid gut.

(2) In infants up to two years. Intussusception.

(3) At any age after infancy. Appendicitis, strangulated hernia, intestinal obstruction.

(4) In adults. Perforated ulcer, cholecystitis, pancreatitis, diseases of the female pelvic organs.

These "surgical" lesions are to be diagnosed from "non surgical" lesions such as gastro-enteritis, pyelitis, renal colic, pleurisy and pneumonia.

Investigation of Acute Abdominal Disease

History. In acute abdominal diseases a full history is of immense value, and indeed may alone suffice to support a tentative diagnosis. First the history of the present illness should be elicited, with special reference to the pain, vomiting and other features mentioned below; then a full history of previous illnesses should be obtained. Even in the simplest cases this part of the investigation should never be neglected.

(1) **Pain.** Pain is a symptom, generally the predominant one, in almost all acute surgical lesions within the abdomen. Especial enquiry should be directed towards the following points:—

Mode of Onset. In perforations the pain is sudden and dramatic; in acute obstruction it rapidly becomes severe; in appendicitis it generally takes a few hours to develop its maximum intensity.

Character of the Pain. In perforations the pain is intense and burning; in obstructions it is spasmodic and colicky; in inflammations it is aching or throbbing.

Site of Pain and Radiation. In perforations the pain originates over the perforation and spreads rapidly over the whole abdomen; in intestinal obstruction it is mainly referred to the umbilical region; in biliary and renal colic it has a characteristic distribution; in inflammations it is most marked over the inflamed area, in appendicitis it generally starts in the

midline of the upper abdomen and later settles over the site of the appendix but it may be localised to that site from the start

Relation of the Pain to Vomiting Micturition Respiration In appendicitis the pain usually precedes the vomiting, whereas in gastro-enteritis it usually follows it in pyelitis and stone in the ureter the pain is associated with frequency of micturition in lesions irritating the diaphragm—pleurisy pneumonia, perforation etc.—the pain is increased on deep inspiration and there is a catch in the breath.

(2) **Vomiting** The time of onset of vomiting its frequency and the character of the vomit are all features of diagnostic importance. In appendicitis vomiting is not the main feature, it rarely recurs more than once or twice and is never severe the vomit is of gastric contents In perforations vomiting is never severe and is often absent In cholecystitis there are much nausea and often repeated vomiting of bile. In pancreatitis the vomiting is accompanied by much retching In intestinal obstruction vomiting occurs with increasing frequency and in increasing amount, the vomiting consisting first of gastric contents, later of bile and duodenal juice finally of brown highly offensive jejunal fluid.

(3) **Bowels.** In most acute surgical diseases the bowels are constipated. In intestinal obstruction one or even two normal motions may be passed until the bowel below the obstruction is empty but after that neither fæces nor flatus can be expelled despite repeated enemas.

In pelvic peritonitis due to an inflamed appendix overhanging the pelvic brim, some diarrhœa is the rule. A pelvic appendix may thus be mistaken for enteritis or even typhoid fever

The character of the stools is occasionally of importance. If no stool has been kept, traces on the finger tip after rectal palpation should be examined.

History of Previous Illnesses. The previous history often gives valuable help in the diagnosis. In appendicitis there is sometimes a history of one or more attacks of pain, similar to though less severe than the present one sometimes a previous attack has been treated as threatened appendicitis. In perforated ulcer there is nearly always an old history of chronic indigestion, though it may be difficult to elicit from a patient agonised by acute pain. In cholecystitis a history of flatulent dyspepsia or of previous attacks of biliary colic may be obtained. In obstruction due to a carcinoma there is almost always a history of progressive difficulty with the bowels. In disorders of the female pelvic organs there may be a history of menstrual irregularity or of leucorrhœa.

General Examination. It must be emphasised that in the early stages of many abdominal emergencies the general appearance is that of perfect health. Older text books describe the abdominal facies, with ashen countenance, drawn features and sunken eyeballs, but this appearance is typical only of the late and generally hopeless stages of such diseases as obstruction or diffuse peritonitis. In the early stages of appendicitis, or even of such grave conditions as obstruction or

perforated ulcer, the facies may be unaffected and the pulse, temperature and respiratory rate may be within the normal range.

The general examination is of greater value from another standpoint, namely to exclude lesions simulating acute surgical emergencies. A high respiratory rate, and especially a high respiration/pulse ratio point to pneumonia. Conversely a temperature above 102 F or a thickly coated or dry tongue weighs the scales against a diagnosis of appendicitis. In all cases the heart and lungs should be examined. The urine must be tested for albumin, and in some cases a centrifuged deposit must be stained for pus cells and organisms.

Abdominal Examination. *Inspection* is carried out first. The contour of the abdomen is observed and any localised fullness or retraction noted Then the movements of the abdominal wall on respiration should be noted In peritonitis the lower part or the whole abdominal wall is immobilised by muscular guarding

Palpation is carried out very gently with the flat of the fingers to estimate slight degrees of muscular guarding The palpation should be begun in the quadrant furthest away from the painful area and extended inch by inch towards it, comparing the two sides Muscular guarding is caused by irritation or inflammation of the parietal peritoneum, and is a most valuable sign of a subjacent infective process.

Finally, deep palpation is carried out to estimate more obvious rigidity to elicit deep tenderness, and to feel any abnormal swelling This part of the examination must also be done gently to avoid undue pain.

The hernial orifices must always be examined The special examinations described on p 870 should be carried out.

The rectum should be examined whenever a pelvic disorder is suspected, and indeed in all atypical cases. Rectal examination is especially valuable in pelvic appendicitis, for the pelvic appendix may cause little or no abdominal rigidity or tenderness, but can always be recognised by extreme tenderness on forward pressure from the rectum.

Special Investigations In addition to routine blood and urine examinations, such special tests as electrocardiography and X ray examination may be needed.

Indications for Operation

In acute abdominal disease an exact diagnosis is not always possible, and not necessarily of vital importance, although it should always be essayed. It is important, however to distinguish the case that can safely be treated on expectant lines from that for which surgical treatment is necessary or for which at least a surgical opinion is advisable.

There is no short cut to the solution of this problem, no rule of thumb by which a "surgical abdomen" may be distinguished from a non-surgical one. As a rough guide, however it may be said that surgical advice should be sought under the following conditions —

(1) Abdominal pain accompanied by localised or generalised

muscular guarding (though operation is not necessarily indicated, e.g in cholecystitis)

(2) Abdominal pain accompanied by tenderness on forward pressure from the rectum (the pelvic appendix)

(3) Abdominal pain accompanied by stoppage of the bowels, unrelieved by enemas.

(4) Abdominal pain with a lump at a hernial orifice.

(5) Abdominal pain, especially if accompanied by vomiting lasting more than three or four hours and not demonstrably due to a non-surgical disease.

Apart from such a rough guide, the only satisfactory method is to attempt as exact a diagnosis as possible, and to decide between expectant and active treatment accordingly In the majority of cases the history points clearly to a particular group of lesions. Abdominal pain shifting early to the right iliac fossa, for example, suggests appendicitis, with such other possibilities as mesenteric adenitis, a leaking duodenal ulcer pyelitis, or a lesion of the right tube or ovary In such a case the history is considered in greater detail and the examination carried out to distinguish between the various possible lesions, and in this way their number is reduced and the probable diagnosis made.

The inexperienced practitioner should attempt in the first place to diagnose the more common diseases rather than to spot rarities. Perforated ulcer is fifty times commoner than the gastric crisis of tabes, and the risk of operating on a tabetic is infinitesimal compared to the risk of missing a perforation. If in doubt after a full examination, it is generally safe to wait for an hour and then re-examine. It is not wise, however to wait overnight, for much can happen within the peritoneal cavity between midnight and sunrise. If on re-examination the diagnosis is still obscure, it is generally advisable to seek a second opinion. Until the final decision has been made, no morphia should be given, even though the pain is severe, for it will mask the symptoms and perhaps encourage dangerous procrastination.

CHAPTER 34

THE STOMACH AND DUODENUM

Investigation of Dyspepsia

The Clinical History The history is often of more value than the physical examination It should therefore be taken with care and with attention to every detail In particular the following points should be noted —

(1) Duration of symptoms—long in ulcer and other forms of chronic dyspepsia, comparatively short in most cases of carcinoma.

(2) Progress of the disease—intermittent in ulcer variable in other dyspepsias, progressively worse in carcinoma.

(3) Pain—its situation and character its relation to food its regularity or variability its relief by food or alkalies or by vomiting

(4) Vomiting—its frequency its relation to pain or to the taking of food the amount and character of the vomitus

(5) Hæmorrhage—hæmatemesis or melæna.

(6) Other dyspeptic symptoms—heartburn, waterbrash, eructations, flatulence.

(7) The general health, appetite, bowels, weight.

The Clinical Examination. Inspection of the abdomen may reveal some extragastric swelling or generalised fullness of such a nature as to *suggest intestinal distension. Generally however inspection gives* little positive evidence in gastric and duodenal diseases, except perhaps to emphasise loss of weight in cases of carcinoma.

Palpation is done to discover any abnormal mass, or to elicit deep tenderness, while percussion of the abdomen will determine the density of a palpable mass or elicit evidence of free fluid.

Succussion is practised to determine if the stomach is dilated. It is carried out by shaking the left upper quadrant of the abdomen with one hand over the epigastrium and the other over the lower ribs It is misleading if performed within three hours of a meal.

Finally the hernial orifices should always be examined and rectal examination may also be required.

In many cases of dyspepsia abdominal examination yields little positive information. *A careful examination of the whole patient should* always be carried out, for it must be remembered that dyspepsia is *a common symptom of pulmonary* tuberculosis and of kidney disease, while vomiting is one of the cardinal features of brain tumour or of incipient uræmia. The stool should be examined for blood

Gastric Analysis. The fractional test meal technique is in common use, but is really of very little value. The acidity of the sample tested is liable to error from dilution by food or saliva or duodenal juice more-

over, with a few exceptions any degree of acidity may be found in any type of disease. In peptic ulcer for example, while the acid level is usually high it may be very low while in carcinoma of the stomach, although complete achlorhydria is usual the acid may be normal or even high.

The main value of gastric analysis is to exclude the true achylias, e.g atrophic gastritis and pernicious anæmia. This is best done by Kay's augmented histamine test. Antihsan (4 ml) is given subcutaneously and half an hour later four times the standard dose of histamine acid phosphate (2 8 mg for a man of average weight) The gastric juice is then collected for forty five minutes by continuous suction through a stomach tube.

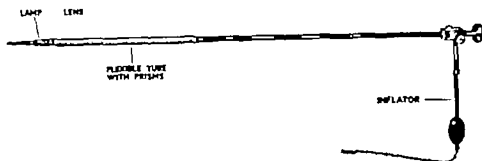


Fig. 207 Gastroscope.

Other observations formerly made on gastric juice, for example, the examination for blood bile, mucus starch, yeast, malignant cells, have outlived their period of usefulness

Gastroscopy The modern gastroscope is a flexible instrument with a complex system of lenses which affords a view of every part of the stomach. Before the examination the stomach is washed out, morphine is given and the throat is anæsthetised by gargling with anethane. The instrument is passed blindly but with great care to avoid injury to the œsophagus

Gastroscopy is valuable in the diagnosis of ulcer or carcinoma of the stomach and certain types of gastritis.

Radiography Radiographic examination is of great value in the investigation of dyspepsia, and should rarely be omitted. First a simple radiograph should be taken to exclude such causes of abdominal pain as renal calculi or spinal disease. Then a barium series is carried out to demonstrate the alimentary tract. The meal, consisting of 4 oz. of barium sulphate in gruel or Benger's food, is given on an empty stomach, and screen examination is carried out with the patient erect and then supine. Further radiographs are taken after two or three hours, and again after six, twelve, twenty four and forty-eight hours, as may be indicated. In certain cases cholecystography pyelography and investigation by barium enema may also be required.

FOREIGN BODIES IN THE STOMACH

Coins, beads and other small smooth articles, often swallowed accidentally by children, may lie in the stomach for several days or weeks, and give rise to pain and vomiting. They generally escape by the pylorus and are eventually passed naturally by the rectum.

Sharp objects, such as pins or nails, also may pass naturally without undue damage, but more often they become embedded in the wall of the stomach, causing pain and tenderness on pressure. In such cases operation should be performed, the pin being pushed point first through the stomach wall, and thus extracted.

Multiple objects, including nails, screws, dinner forks, etc., may be *swallowed by mental defectives.* They should be removed by operation.

Hair ball occurs in young girls, or mental defectives of any age, as a result of biting the hair or of swallowing other fibrous material. The hair ball forms in the stomach and may attain large size, giving rise to pain, vomiting and loss of weight. On examination, the mass may be palpable as a mobile tumour in the epigastrium. The diagnosis is confirmed by radiography, which demonstrates a mottled defect within the barium shadow. The treatment is to remove the ball by operation.

GASTRIC AND DUODENAL ULCER

Ulcer of the stomach or duodenum has increased greatly in frequency since the early part of the century and is now an exceedingly common disease. Duodenal ulcer affects men much more often than women. In gastric ulcer the difference is less marked.

The ulcer starts as an acute erosion of the mucous membrane of the stomach or duodenum. Most ulcers heal rapidly, a few enlarge acutely and lead to hæmorrhage or perforation, while the remainder

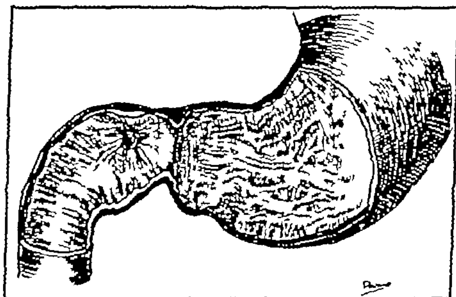


FIG. 206. Duodenal ulcer.

pursue a chronic course, with subacute exacerbations Chronic ulcers may bleed or perforate at any time, and eventually may lead to cicatricial stenosis (hour-glass contracture or pyloric stenosis) A chronic gastric ulcer but never a duodenal one may undergo malignant change.

Chronic ulcers occur only in certain sites, the so-called ulcer bearing areas, which are probably determined by the liability of certain parts of the mucous membrane to traumatism from unmasticated food or acid chyme. In the stomach ulcers occur along the "magenstrasse" or gastric pathway, on or close to the lesser curvature; in the duodenum, on the anterior or posterior wall about ½ inch beyond the pylorus, where the acid chyme discharged from the stomach is most apt to impinge.

A chronic gastric ulcer is generally rounded or oval, with a deeply punched-out crater which penetrates the muscular tunic and has a fibrous base composed of indurated subserous coat. Often there are adhesions to adjacent structures, and there may be a large inflammatory mass in the lesser omentum. Rarely the ulcer penetrates the pancreas.

A duodenal ulcer is usually smaller with less surrounding induration but occasionally a posterior ulcer is large and penetrates the pancreas.

Ætiology A peptic ulcer results from erosion of the mucous membrane by the acid gastric juice, and probably is due either to factors, such as spasm, which impair the vitality of the mucosa or to excessive activity of the juice. Vagus stimulation increases the motor and secretory activity of the stomach, hence ulcer is common in persons of "vagotonic type, thin, active, restless and over-conscientious. Often there is a history of ulcer in other members of the family Other factors such as dietary indiscretions, irregularity of meal times and excessive smoking doubtless also play a part.

Clinical Features. The clinical features of gastric and duodenal ulcer are very similar and cannot readily be distinguished. There is usually a long history of dyspepsia occurring in "attacks" lasting a few weeks, with free intervals perhaps lasting months. As the disease progresses the attacks tend to be longer and the intervals shorter and eventually the dyspepsia may be more or less continuous.

Pain is the predominant symptom. Almost always it occurs at a definite time (1 to 2½ hours) after food, and it is relieved by anything which neutralises or dilutes or adsorbs the gastric juice, such as milk or alkali or any kind of a meal.

The pain of a gastric ulcer is said to occur sooner after a meal (1 to 1½ hours) than in duodenal ulcer (2 to 2½ hours) but there are many exceptions. Similarly the site of pain is very variable in gastric ulcer it tends to be near the middle of the epigastrium, in duodenal ulcer a little to the right, but again little reliance can be placed on this feature.

In severe phases the patient is wakened regularly at 2 to 3 a.m. by the pain, which may be so severe as to render him unfit for work.

Other dyspeptic symptoms—heartburn, waterbrash, acid eructations —are common but of no diagnostic value. Vomiting is an occasional feature, particularly in gastric ulcer

Hæmorrhage of slight degree, sufficient to give a positive test for *occult blood in the stools*, is fairly common. Occasionally frank hæmatemesis or melæna occurs, the former principally in gastric ulcer

Abdominal examination may reveal little except slight muscular guarding and deep tenderness over the ulcer and even these signs are not invariable.

X ray Examination This examination gives invaluable information and should never be omitted. Under the fluorescent screen a gastric

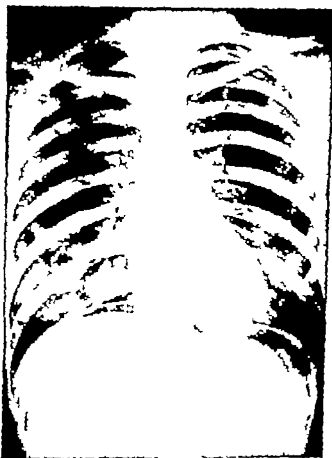


FIG. 209. X ray showing gas under diaphragm in case of perforated peptic ulcer

ulcer can be demonstrated in profile as a niche on the lesser curvature (Fig 212) while spasm at this level may give a so-called notch or deep rounded indrawing of the greater curvature.

A duodenal ulcer can sometimes be demonstrated directly by barium outlining the crater In other cases indirect evidence is provided by a deformity of the duodenal cap, indicating spasm or scarring of the first part of the duodenum.

Gastroscopy This examination is useful to identify a gastric ulcer, to exclude malignancy and to give information as to the presence of gastritis.

Treatment of Gastric and Duodenal Ulcer

Medical treatment is desirable in the great majority of uncomplicated ulcers. The essential features are (1) an initial period of rest in bed, preferably for three or four weeks (2) a dietary *régime*, such as Sippy s, for several months, and modified dietary restrictions for a year or more, (3) alkalies between meals and at nights to prevent hyperacidity (4) belladonna to diminish the motor and secretory activity of the stomach Medical treatment is of greatest value in early cases

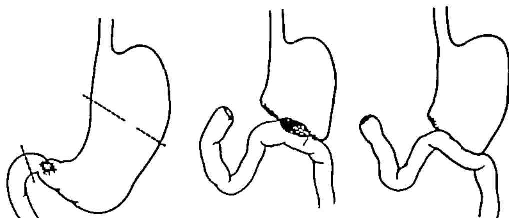


FIG 210 Polya type of gastrectomy (*a*) The amount resected, (*b*) duodenal stump closed and inverted. Part of cut end of stomach closed. Anastomosis to jejunum in progress. (*c*) Anastomosis completed.

In practice it is sometimes not possible to carry out medical treat ment with such thoroughness, owing to social and economic circum stances. In such cases if the symptoms are severe, surgical treatment may be needed as a short cut to health and economic independence.

Surgical treatment is obviously required in the complications of ulcer e.g perforation, some cases of hæmorrhage, pyloric stenosis, hour-glass contracture, and in suspected or proven malignant change.

In uncomplicated cases, the decision to advise surgical treatment depends mainly on the severity of the symptoms. In this connection persistent pain not adequately relieved by alkalies, nocturnal pain, and pain passing deeply through to the back deserve special consideration.

Surgical treatment is generally not advisable in early cases In duodenal ulcer it is not usually advisable when the duration is less than five years.

The type of operation to be performed is still under debate. For gastric ulcer partial gastrectomy is almost always advisable and at

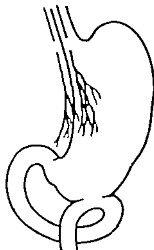


FIG 211 Gastrojejunostomy with vagotomy

the present time most surgeons prefer the Polya type of gastrectomy in which the residue of stomach is anastomosed to the jejunum.

In duodenal ulcer two types of operation are in vogue, a Polya gastrectomy or alternatively, gastrojejunostomy combined with vagotomy. It is generally believed that gastrectomy carries a smaller risk that a secondary ulcer (stomach ulcer) will develop near the anastomosis but it does carry a liability to the "dumping syndrome" which in severe cases is quite disabling. Gastrojejunostomy combined with vagotomy is relatively free from this complication. It is also not so severe an operation as gastrectomy so it is to be preferred in elderly or poor risk cases.

Late symptoms after gastrectomy constitute the "*post gastrectomy syndrome*" or the "dumping syndrome," due to rapid dumping of food from the stomach into the small intestine. Within a few minutes of a meal the patient feels marked epigastric distension with muscle weakness and sometimes faintness so that he may have to lie down. Sometimes this phase is followed by bilious vomiting and occasionally mild diarrhoea.

Complications of Gastric and Duodenal Ulcer

These complications include (1) hæmorrhage (2) perforation (3) pyloric stenosis (4) hour-glass contracture (5) malignant change.

Bleeding Peptic Ulcer

A bleeding gastric ulcer usually gives rise to hæmatemesis: the vomit consists of "coffee grounds" material, due to digestion by the acid juice. This is followed by melæna, the fæces being tarry in appearance. Profuse bleeding from a duodenal ulcer also causes hæmatemesis by reflux through the pylorus. Less severe bleeding from either type of ulcer causes melæna alone.

If the hæmorrhage is severe it causes sudden faintness and giddiness, and even unconsciousness. The initial loss of blood is rarely fatal, but if the bleeding is continued for several days the danger is greatly increased.

Diagnosis. Gastro-intestinal hæmorrhage may arise from lesions in the œsophagus (carcinoma, varix, ulcer), in the stomach (carcinoma, ulcer, erosion) in the small intestine (polypus, carcinoma, rarely Meckel's ulcer). In practice massive hæmorrhage is rare apart from ulcer, gastric erosion and œsophageal varix. Hæmatemesis must, of course, be distinguished from the vomiting of blood swallowed from a lesion in the naso-pharynx. In making the diagnosis, account must be taken of any history of dyspepsia, though this is lacking in 10 per cent. of cases.

While a full X ray examination is not possible in the exsanguinated patient, it is often advisable to give a "barium swallow" to exclude œsophageal varices.

Treatment. The treatment of a bleeding peptic ulcer should generally be conservative. Morphia is given to calm the patient and

to overcome the restlessness characteristic of acute blood loss The foot of the bed is raised to conserve blood for the vital centres Except in mild cases a transfusion should be given and in severe cases several pints of blood will be required.

A careful watch must be kept, for evidence of further bleeding The most valuable index is the pulse rate, which must be charted half hourly The blood pressure should also be watched The hæmoglobin index is fallacious for after bleeding it only falls slowly as the blood is diluted by tissue fluid.

A stomach tube should be passed, preferably a 7 mm. tube inserted through the nose, and the stomach emptied. A milk drip is given, and from time to time a sample of the gastric contents is withdrawn as a check against further bleeding

If after twenty four to thirty six hours' treatment it is thought that the bleeding is persisting or if at any time thereafter the bleeding recurs, it is generally advisable to recommend gastrectomy, provided that a skilled surgical team is available. Most surgeons favour operation, particularly in patients over fifty years of age, in whom under conservative treatment the risk is high. Operation is preceded and followed by massive transfusion.

Perforation

'Perforation' unqualified implies acute perforation into the peritoneal cavity and is a complication apt to occur if the ulcer is situated on the anterior wall of the stomach or duodenum.

Duodenal perforations are far commoner than gastric perforations, for the duodenal wall is thin and unresistant. Gastric perforations, on the other hand are more dangerous, for the aperture is generally of large size, and there is a free escape of highly irritating infective fluid.

When a perforation occurs, the irritant fluid is diffused through the peritoneal cavity and sets up a widespread peritoneal irritation or peritonism. An exudate is then rapidly poured out, which dilutes the irritant and mitigates the pain. Until this stage the whole process has been aseptic, but now organisms pour out from the stomach or duodenum and lead to diffuse peritonitis, which if untreated will prove fatal.

Rarely an ulcer may perforate into the lesser peritoneal sac, giving rise to a localised peritonitis which may go on to form a subphrenic abscess.

Clinical Features. *Stage of Peritonism.* The onset of a perforation is characterised by sudden intense pain, originating in the epigastrium but quickly spreading over the whole abdomen. The pain is continuous and severe, and, as it is intensified by movement, the patient holds himself rigid and resents any attempt to alter his position. Occasionally pain is felt in the shoulder tip as a result of the phrenic reflex from the irritated diaphragm. Vomiting may occur but is not a regular feature and is not severe.

On examination, the patient is seen lying rigid fearing any movement. His expression is drawn and anxious. There may be some

shock, but usually the pulse is full, regular and but little increased in rate. The temperature is subnormal. The respiratory rate is slightly increased and there may be a catch in the breath at the end of inspiration

The abdomen is held rigid and immobile It is somewhat retracted, often with a transverse sulcus close above the umbilicus. Superficial hyperæsthesia may be present in the epigastrium, especially if the ulcer is close under the parietal peritoneum. On palpation, the muscles of the abdominal wall are felt to be rigid and board like, especially in the epigastrium. The liver dullness may be reduced as a result of free gas in the peritoneal cavity but this sign is not often present, and on the other hand it may be simulated by distension of the colon. On auscultation peristaltic sounds are usually absent, but this sign also is not invariably present.

Stage of Reaction When the initial peritoneal irritation has been lessened by the outpouring of peritoneal exudate, the pain becomes somewhat easier any shock present in the first stage passes off and the patient may feel distinctly better The clinical signs, however remain the same Occasionally dullness may be elicited in the flanks owing to the presence of free fluid At this stage also the temperature rises a degree or so

Stage of Peritonitis This stage, in which the element of infection predominates, appears within four to eight hours. It is characterised by rapid deterioration in the general condition The features are drawn, the pulse is rapid and weak, the circulation is embarrassed and the respiratory rate increased The abdomen becomes distended and drum-like. Vomiting occurs frequently small mouthfuls of greenish or brownish fluid being brought up If untreated, the peritonitis progresses rapidly and is fatal, generally within two or three days.

Diagnosis. The diagnosis is to be made from (1) other perforative lesions, e.g of the appendix (2) colics, e.g biliary or intestinal and (3) pleurisy or pleuro-pneumonia. Generally the dramatic onset of severe pain and the generalised rigidity suffice to make the diagnosis clear A history of previous indigestion is helpful, but cannot always be obtained from a patient in the throes of acute pain.

In doubtful cases a straight X ray taken with the patient propped up may confirm the diagnosis by revealing free gas below the diaphragm (Fig 209)

Treatment. The treatment is to open the abdomen through an incision in or close to the midline of the epigastrium, and to find and close the perforation When the abdomen is opened, free gas and turbid fluid escape The stomach should then be retracted towards the left side to expose the commonest site for a perforation—the anterior wall of the duodenum. If not found there it should be sought along the lesser curvature of the stomach. The perforation is closed by multiple fine sutures of silk or catgut, reinforced if necessary by an omental graft. The exudate should then be mopped out thoroughly In late cases, or if much foreign matter has escaped, a rubber strip

or tube should be inserted through a midline suprapubic wound to drain the pelvis. If severe pyloric stenosis is present, gastrojejunostomy may be required at the time of the perforation or (if the general condition does not permit) it may require to be delayed for a week or so

Conservative treatment has been advocated, but is not to be recommended as a routine. It is valuable however, in late cases (twenty four hours or more) where the clinical picture leaves no doubt that the leak has been sealed In such cases the stomach is evacuated and kept empty by constant suction the fluid and crystalloid balance is maintained by intravenous infusion, and antibiotics are administered. A close watch must be kept on the patient, with two-hourly pulse charts, for operation may be called for if the leak re-occurs.

In a few cases, seen early and treated by a skilled surgeon, primary gastrectomy may be carried out. It is especially advocated for gastric perforation owing to the risk of malignancy

Prognosis. The mortality from perforation has fallen markedly with earlier treatment, the introduction of antibiotics and other improvements in after care, and is now less than 5 per cent. Death is most likely to occur in late cases, especially when there has been gross contamination from a large perforation of a gastric ulcer

After perforation the ulcer may heal completely but recurrence of indigestion is common. Medical treatment should be enforced for at least six months. Later if symptoms recur a gastrojejunostomy or gastrectomy may prove necessary

Leaking Duodenal Ulcer

An anterior duodenal ulcer may develop a minute perforation sufficient only to allow a slight leak of gas and fluid The leak may be shut off by adhesions and give rise to a localised abscess, but more often it enlarges, and after a few hours approximates to the common type of acute perforation.

The first symptom is pain over the ulcer occurring abruptly but without the dramatic intensity of a large perforation. Since the fluid tends to gravitate along the right paracolic gutter and irritates the peritoneum of the right iliac fossa, the pain soon spreads downwards. Thus the condition may be mistaken for acute appendicitis. The distinguishing feature is that, though the pain is felt in the lower part of the abdomen, the muscular rigidity is most marked over the ulcer and deep tenderness may also be elicited in this region. X ray evidence of gas under the diaphragm will confirm the diagnosis.

The treatment is the same as for acute perforation.

Hour-glass Contracture of Stomach

This type of contracture occurs mainly in elderly women. As a result of long-standing fibrosis the greater curvature opposite the ulcer is drawn up towards the lesser curvature so that the stomach is divided into two sacs communicating by a narrow aperture The ulcer may remain active or heal.

The diagnosis is confirmed by radiography after a barium meal which

demonstrates the smoothly outlined upper sac, with barium spilling out of a "tea-spout" orifice into the lower sac. The *crater of the ulcer* may also be outlined (Fig 212)

The treatment is by operation. Gastrectomy is usually the method of choice.



FIG. 212. Hour-glass contracture and pyloric stenosis due to coincident gastric and duodenal ulcers. The crater of the *gastric ulcer is visible* as a niche on the lesser curvature just proximal to the "tea-spout" orifice of the upper sac. Note the excessive peristalsis involving the lower sac due to early pyloric obstruction.

Pyloric Stenosis

Pyloric stenosis may occur as a congenital deformity (p 405) or result from carcinoma or duodenal ulcer The last type is the commonest.

The narrowing is usually due in part to fibrosis, in part to inflammatory swelling in the vicinity of the ulcer The stomach at first hypertrophies to overcome the obstruction, and later becomes atonic and dilated. Its contents then stagnate and ferment, and from time to time are vomited

The history in most cases is one of long standing periodic dyspepsia with typical hunger pain, though rarely the original ulcer has been symptomless As the stenosis develops, the pain loses its characteristic relation to food and becomes more continuous, while vomiting, rare in uncomplicated duodenal ulcer, occurs with increasing frequency and in increasing amount. The vomitus is of sour dark-coloured fluid, and may measure 2 pints or more. In late cases food may be vomited after being retained in the stomach for twenty four hours or longer

If the stenosis increases there is loss of weight owing to starvation. Sometimes the loss of fluids and chlorides by vomiting is so great as to cause dehydration and alkalosis. Headache then occurs, the tongue is dry, the urine is scanty and high coloured. In exceptional cases the condition of gastric tetany develops, with muscular irritability manifest in spasms of the hands and feet similar to those seen in the tetany after parathyroidectomy (p 319).

Examination of the abdomen by succussion (p 388) demonstrates splashing in the stomach except in an early case.

Radiography after a barium meal in an early case shows the stomach somewhat dilated and hypertonic, often with exaggeration of peristalsis. The duodenal cap is small and greatly deformed by the cicatrised ulcer In a later case, when the stomach is atonic, the heavy barium gravitates to the most dependent portion, which often lies low in the abdomen, or even in the pelvis, and there forms a flat topped shadow of "soup-plate" appearance (Fig 214) The degree of stenosis is indicated by the



Fig. 213. Pyloric stenosis due to duodenal ulcer The stomach is greatly dilated and hyperperistaltic. The duodenal cap is *small and deformed.*



Fig 214 Pyloric stenosis due to duodenal ulcer At this late stage the stomach is enormously dilated and atonic, so that the barium *gravitates into the pelvis.*

amount of gastric stasis. Normally the stomach should empty completely in three or four hours in severe stenosis almost the whole of the meal may be retained for over twenty four hours.

The treatment in early cases is as for uncomplicated duodenal ulcer (p 393) In late cases with dehydration and alkalosis, fluids and electrolytes may be needed in large amounts. After this preparation a gastrojejunostomy should be performed.

Ulcer-Cancer

Malignant change may occur in a chronic gastric ulcer though it is probably less common than was formerly thought. The resulting carcinoma differs in no way from a carcinoma arising primarily (see p 400) A duodenal ulcer remarkably enough, never undergoes malignant change.

Gastrojejunal Ulcer

This is a secondary ulcer occurring close to the suture line of a gastrojejunostomy or a partial gastrectomy It arises mainly in cases where the original operation has been performed for duodenal ulcer and consequently is commonest in males It is especially apt to occur if the gastric acidity is high.

The anastomotic ulcer may occur soon after the operation or after a lapse of several years. Generally it gives rise to recurrent indigestion with attacks of vomiting The pain is felt mainly over the stoma, close to the left of the midline. It is worse shortly after a meal, and may be severe and incapacitating Occasionally the ulcer causes no pain, but gives rise to recurrent hæmorrhage, sometimes severe

Abdominal examination reveals tenderness over the stoma, and in some cases there is a palpable mass of inflammatory tissue.

The diagnosis is to be made from recurrence of the original duodenal ulcer Radiography after a barium meal will demonstrate irregularity and spasm at the stoma, with delay in the passage of food through it. Gastroscopy will often confirm the presence of the ulcer

The treatment in the first place is by medical measures If these fail operation is indicated. The type of operation to be performed varies according to the precise state of affairs found Generally it is necessary to resect the affected portion of jejunum and perform gastrectomy

Gastrocolic Fistula

This condition is generally a sequel to a gastrojejunal ulcer that has penetrated into the colon

If the aperture is of small size, the main feature is that colon gas escapes into the stomach and may be eructated. If it is larger stercoral matter may be vomited while the passage of fæces into the jejunum leads to enteritis with intractable diarrhœa, severe loss of weight, and emaciation In some cases malnutrition leads to protein deficiency with œdema of the extremities. In others, unaccountably enough, the symptoms vary in severity and may even abate for long periods

The diagnosis is confirmed by radiography after barium meal or preferably barium enema.

The treatment is by operation In favourable cases it is possible to separate the two viscera and close the communication between them. Generally it is necessary also to resect the affected portion of jejunum and perform gastrectomy In a debilitated patient a colostomy should be performed, opening the bowel near the hepatic flexure, thus diverting the fæcal content to the surface and preventing its reflux through the fistula.

CARCINOMA OF THE STOMACH

This common disease occurs mainly between the ages of 40 and 60 years In a small proportion of cases it arises as a sequel to chronic

gastric ulcer With rare exceptions the growth is an adenocarcinoma derived from the columnar epithelial cells of the gastric mucosa.

The growth generally arises at or close to the lesser curvature towards the pylorus. In some cases it is a small scirrhous type of growth, which infiltrates the stomach wall and tends to constrict the pylorus; in others it is larger and more florid and projects as an ulcerating mass into the lumen where it ulcerates extensively bleeds readily and becomes heavily infected

The growth spreads extensively in the stomach wall, though remarkably enough, it is slow to invade the duodenum. The glands are involved very early, first those round the pylorus and in the lesser omentum, later those along the cœliac axis and the aorta. The tumour also spreads to the liver at an early stage, and in addition malignant cells may be disseminated through the peritoneal cavity

Rarely a leather bottle type occurs, which infiltrates widely in the stomach wall but is comparatively late in spreading more distantly

Symptoms. Typically the onset is insidious, and the early symptoms do not point directly to the stomach. The main features are loss of appetite, loss of energy and loss of weight. Anæmia may be present, due to recurring slight ooze of blood Occasionally diarrhœa is an early sign due to infection of the ulcerating growth or constipation due to the restricted diet. In a middle-aged person these features should always indicate the need for a thorough examination. In particular anæmia in a middle aged patient should be looked upon with suspicion and treatment whether by iron or liver should not be started until repeated tests for fæcal occult blood have proved negative.

Pain may be felt in the epigastrium, but is rarely severe. It is generally vague in character and not definitely related to food Short of pain, there may be a complaint of vague indigestion Vomiting sometimes occurs and vomitus may be tinged with blood. The stools also may contain small amounts of blood, sufficient to give the chemical tests for occult blood.

Atypical cases are not infrequent. If the growth is small and situated close to the pylorus, the symptoms are those of pyloric stenosis (p 398) with vomiting of increasingly large amounts of sour fluid If the growth is close to the cardia, the main feature may be dysphagia.

Clinical Examination. The general appearance in late cases suggests the diagnosis, for typically the patient has obviously lost weight and is pale thin and anæmic. Sometimes the anæmia is so marked as to suggest pernicious anæmia.

Abdominal examination may reveal a palpable hard lump in the region of the pylorus or lesser curvature, but often the growth is *high* up, under cover of the ribs, and cannot be palpated.

In an established case the examination should include a search for secondary growths The liver should be palpated, the rectum examined for nodules on the pelvic floor the vagina for metastases on the ovaries. The abdomen should be percussed for free fluid, indicative of peritoneal metastases. The umbilicus should be examined for secondary nodules,

which may spread there along the ligamentum teres The chest should be examined for secondary growths in the lungs or pleuræ. Finally the glands at the root of the left side of the neck should be palpated, for in rare cases they are involved by spread along the thoracic duct.

Investigations *Achlorhydria* is usually present, but not always, and in a small proportion of cases there is hyperchlorhydria. For this reason the *test meal* may be misleading Traces of blood may be present and often there is an excess of mucus *X ray examination* gives valuable evidence. In an early case the first sign, visible on screen examination, is that peristalsis is interrupted opposite the tumour owing to involve-



FIG. 215. Carcinoma of the pyloric part of the stomach. The growth has caused a partial obstruction of the pylorus and forms a massive filling defect in the barium shadow It is unusually smooth in contour.



FIG 216. Leather bottle carcinoma of the stomach. The stomach is small, high and fixed. There is no pyloric obstruction. Secondary dilatation of the œsophagus is evident.

ment of the muscle coat. Later there is a filling defect, irregular in shape but constant in successive radiographs If the tumour is a small one close to the pylorus, the appearance is closely similar to that of simple pyloric stenosis (p 398) *Gastroscopy* is useful in some cases. *Cytology* is useful in early cases. Through a fine stomach tube, 100 ml. saline is injected into the stomach and withdrawn. The centrifuged deposit is stained and searched for malignant cells.

Treatment The treatment in an early case is by gastrectomy with removal of the glands near the pylorus and in the lesser omentum. The resection must be a wide one, extending from the duodenum to a point well above the visible tumour

If the growth cannot be removed it is sometimes useful to perform

gastrojejunostomy, especially if pyloric obstruction is present. Radiotherapy is useless for gastric carcinoma.

Resection of the cardiac portion or even total gastrectomy may be performed in extensive disease.

Rare Tumours of the Stomach

Polypi (papillary adenomata) occur They are generally multiple, and form rounded pedunculated masses which bleed readily and may cause considerable anæmia and cachexia They are visible on radiography as smooth rounded filling defects in the shadow of the barium The treatment is to remove a single polypus or to perform gastrectomy if there are multiple polypi

A *leiomyoma* forms a smooth rounded tumour often of considerable size. It may project into the lumen and form a pedunculated mass which is very apt to cause recurrent obstruction of the pylorus with attacks of pain and vomiting or it may project externally and press upon neighbouring viscera. The treatment is to remove the tumour with an ellipse of stomach wall.

A *sarcoma* is a rare tumour of the stomach It forms a large fleshy mass which bleeds readily and becomes heavily infected, giving rise to marked anæmia and cachexia. The treatment in an early case is to perform gastrectomy

CONGENITAL PYLORIC STENOSIS

This is a disease of young infants, especially males, and especially the first born of a family It is characterised by pyloric obstruction with hypertrophy of the circular muscle fibres of the pyloric canal. The view held at present is that the primary factor is an achalasia (failure to relax) of the pylorus, due to neuro-muscular inco-ordination, and that the muscle of the pyloric canal hypertrophies in order to overcome the functional obstruction so caused

The child is healthy at birth, and the first symptoms generally occur in the third week, though exceptionally as early as the third day or as late as the sixth week. The main symptom is vomiting which starts as a small regurgitation at the end of each feed and progresses until the greater part of each feed is brought up

As a result the child fails to put on weight, and then actually loses weight, becoming pale and emaciated The appetite remains good hunger is indicated by thumb sucking, and there is no retching nor evidence of indigestion.

Abdominal palpation may reveal a firm lump the size of an olive—the thickened pyloric muscle. In late cases if the child is examined during a feed, waves of gastric peristalsis may be observed passing from under the left costal margin down to the region of the umbilicus.

The diagnosis is to be made from (1) gastritis, due to faulty diet (2) congenital duodenal atresia, which gives rise to vomiting from birth and (3) volvulus of the mid-gut loop (p 415) which generally occurs within a few days of birth and progresses rapidly

If medical measures fail to give prompt relief, Rammstedt's operation should be carried out without delay The pylorus is exposed under general or local anæsthesia through a small incision splitting the right

rectus muscle, and the thickened muscle of the pyloric canal is divided longitudinally down to, but not through, the mucosa. The abdominal wall is then closed Careful post-operative feeding is necessary to avoid risk of gastro-enteritis

VOLVULUS OF THE STOMACH

In this rare condition the stomach rotates generally in such a way that the greater curvature is carried forwards and upwards under the diaphragm The volvulus is most apt to occur in the presence of an hour-glass constriction or a tumour of the stomach or adhesions which act as an axis for rotation.

Both orifices of the stomach cardia and pylorus may be occluded and the stomach becomes enormously distended with fluid and gas. There is acute abdominal distress with rapid collapse. Retching is a prominent feature and any fluid taken by mouth is promptly regurgitated.

The treatment is to open the abdomen and replace the stomach in position. To render this possible the distension must be relieved by stomach tube.

ACUTE DILATATION OF THE STOMACH

The stomach may undergo acute dilatation as part of a general distension of the alimentary canal in intestinal obstruction and in paralytic ileus The term " acute dilatation however is generally applied to a condition which may occur within a few hours of operation in which the stomach becomes enormously distended with fluid and gas and fills almost the whole abdomen.

It is now recognised that this condition which may occur after any type of operation is due to distension by swallowed air ingested during the post operative phase of vomiting or retching or hiccup It is readily treated by continuous suction through a stomach tube. The fluid and electrolyte balance must be restored by intravenous infusion

CHRONIC DUODENAL ILEUS

This rare disease is characterised by recurring obstruction at the third part of the duodenum. In some cases it is due to an organic lesion at that point, an adhesion or the pressure of a tuberculous gland in others mainly females of visceroptotic habitus the obstruction is due to constriction of the duodenum by the mesenteric vessels drawn tight by the pull of ptotic intestinal coils overhanging the pelvic brim

The ileus recurs at intervals giving rise to severe attacks of bilious vomiting The diagnosis is to be made by radiographic examination which demonstrates stasis in the dilated duodenum. It has been advised to anastomose the dilated third part of the duodenum to the proximal jejunum but the results are disappointing

DUODENAL DIVERTICULA

Apart from secondary pouching in the neighbourhood of an ulcer duodenal diverticula occur mainly on the concavity of the second and third parts of the duodenum especially in relation to the bile and pancreatic ducts

They consist of small herniations of mucous membrane through a gap in the muscular coat, generally alongside one of the vessels supplying the duodenal wall. Arising on the basis of a developmental defect, they are found mainly in adults

The great majority are symptomless and are found by chance on X-ray examination They require no treatment. In particular surgical treatment should be avoided, for the diverticulum may be deeply placed and difficult of access and its removal is not free from risk.

CHAPTER 35

THE INTESTINES

MECKEL'S DIVERTICULUM

THE vitelline duct, which in the embryo connects the yolk sac with the small intestine *via* the umbilical orifice normally undergoes complete obliteration, but it may persist in whole or in part and give rise to various malformations.

Complete persistence of the duct gives rise to a fæcal fistula, which appears at the umbilicus a few days after birth and usually tends to close gradually persistence of the part close to the umbilicus gives rise to a blind sinus which may be extruded to form a cherry like swelling covered with red intestinal mucous membrane (enteroteratoma) persistence of the intermediate portion gives rise to a cyst, slung by fibrous bands between the umbilicus and the small intestine (enterocystoma), while persistence of the intestinal end gives rise to the common Meckel s diverticulum.

The Meckel s diverticulum is by far the commonest of these mal formations. It generally takes the form of a finger like process arising from the ileum 2 to 3 feet from the ileo-cæcal valve It is lined by intestinal mucous membrane, and often there are areas of acid secreting gastric mucous membrane. Its tip may be attached to the mesentery by a fibrous cord representing the original vitello-intestinal artery

Complications. (1) As a result of erosion by acid derived from the ectopic gastric mucous membrane, an ulcer may form either in the diver ticulum or in the ileum close by In children this is a common cause of melæna. Rarely the ulcer perforates, giving symptoms resembling a perforated gastric or duodenal ulcer

(2) Inflammation of the diverticulum gives rise to symptoms resembling acute appendicitis. It may proceed to rupture and diffuse peritonitis

(3) Intestinal obstruction may develop The fibrous cord attached to the diverticulum may ensnare a loop of intestine, or the diverticulum may initiate a volvulus or an intussusception.

Treatment. In some cases it is possible to remove the diverticulum alone, and to invert and close the opening into the ileum. In other cases it is better to remove the loop of ileum from which it springs. If intestinal obstruction is present, it may suffice to divide the fibrous band.

MEGACOLON

Two varieties of megacolon are now recognised

Congenital Megacolon Hirschsprung s Disease. This disease occurs nearly always in male children and is probably based on an inherited tendency The primary defect is a maldevelopment, sometimes amount

ing to complete absence of autonomic ganglion cells from the distribution of the pelvic parasympathetic nerves in Auerbach's plexus in the rectum and sigmoid colon. This leads to an achalasia with functional obstruction. As a secondary result the colon becomes greatly dilated and hypertrophied. The dilatation in most cases is limited to the sigmoid colon but it may extend upwards to the hepatic flexure or even further. It is a characteristic of this type that distally the dilatation stops at or about the rectosigmoid junction.

Congenital megacolon gives rise to obstinate constipation from the time of birth. The bowels may remain closed for a week or even a month, unless opened by drastic purgation or enemas. The stools are bulky and soft and offensive. Attacks of diarrhœa may occur as a result of colitis, due to putrefaction of the stagnant content. In spite of this impairment of the bowel action the child's health does not suffer noticeably at first, but later he grows pale, thin, toxic and anæmic. Not infrequently acute obstruction supervenes. In contrast to the general emaciation, the abdomen becomes greatly distended. The outline of the distended colon may be visible and peristalsis may be evident.

In the diagnosis, the main problem is to distinguish congenital megacolon from the "idiopathic" variety. Apart from the history of constipation dating from birth, the main distinguishing feature is that in the congenital type the rectum is empty and contracted so that it grips the examining finger.

The treatment in the first place is to empty the distended colon by repeated enemas. Saline solution should be used in preference to water owing to the risk of retention and absorption and water intoxication. Sometimes it is necessary to empty the bowel manually under anæsthesia. Only in rare cases of persistent obstruction is it necessary to perform colostomy.

The definitive treatment is to resect the aganglionic segment by the operation of rectosigmoidectomy in which the whole rectum and the lower part of the sigmoid are removed, continuity being re-established by end-to-end suture to the mucosa of the anal canal. The usual method is by the "pull through" technique, in which the bowel after being mobilised is pulled down through the anus before being cut across.

Idiopathic Megacolon. This variety develops later in childhood or even, rarely, in adult life, and it differs also in respect that the dilatation extends down right to the anus. It is rarely so severe in its effects as is the congenital type.

In the treatment, operation is generally not required. In the first place the bowel must be thoroughly cleared out, and manual evacuation under anæsthesia may be required. Thereafter large doses of an aperient mixture should be prescribed.

ACUTE INTESTINAL OBSTRUCTION

This is a common and highly dangerous affection, always fatal unless promptly relieved, and even then not free from risk.

In its simplest form there is an uncomplicated occlusion of the lumen of the gut. This sometimes proceeds to the much more dangerous strangulation in which the blood supply to the bowel is impaired.

The condition of "paralytic ileus," which is traditionally classified as a variety of obstruction, is entirely different in character and will be considered separately.

Simple Occlusion

In this condition the lumen of the intestine is occluded, but its blood supply is intact. The gut proximal to the obstruction becomes distended with gas and fluid and the distension gradually extends upwards to involve the jejunum, duodenum and stomach. The gut undergoes violent peristalsis to overcome the obstruction and later undergoes anti peristalsis, which leads to vomiting of intestinal contents. The acute symptoms which develop vary in urgency according to the site of obstruction, being most severe in high obstruction.

Causes Simple intestinal occlusion may be caused by —

(1) Objects within the lumen, e g foreign body gall-stone enterolith.

(2) Lesions of the intestinal wall, e g fibrous stricture carcinoma.

(3) Compression from without e g hernia, band or adhesion a volvulus or an extrinsic tumour

Constitutional Effects. Acute intestinal obstruction very rapidly gives rise to severe constitutional effects The patient looks pinched and drawn, with haggard features and sunken eyeballs. His pulse becomes rapid and increasingly weak his blood pressure is lowered These features were formerly believed to be due to toxæmia and many ingenious theories were propounded They are now known to be due simply to the intense dehydration and electrolyte losses which follow the excessive vomiting and the sequestration of large quantities of fluids within the lumen of the distended gut. The total loss may amount to several litres of fluid The potassium defect may be particularly serious.

Clinical Features. In typical cases the symptoms of obstruction appear suddenly without warning

The first symptom is pain sudden in onset and colicky in nature, associated with violent peristalsis of the obstructed intestine. The pain is generalised and is mainly referred to the umbilicus. It comes on in intense spasms, so that the patient is doubled up To some extent it is eased by pressure or by applying a hot bottle to the abdomen.

Vomiting generally occurs early and in most cases is frequent and profuse. At first the vomitus is of gastric contents, but it rapidly becomes yellow or green from admixture of bile, and within a few hours it may become brownish and offensive (the so-called stercoral or fæcal vomit) owing to retroperistalsis of jejunal contents

The bowels may act once or even twice after the onset of obstruction, evacuating fæces below the site of occlusion but after that neither fæces nor flatus is passed, and enemata are returned clear

On examination, the abdomen is a little distended, and intestinal peristalsis may be visible if the abdominal wall is thin Auscultation

with a stethoscope applied to the abdomen will reveal loud peristaltic noises A hernia may be present, or there may be an operation scar (suggesting the possibility of adhesions as a cause of the obstruction)

Diagnosis. Acute intestinal obstruction must be diagnosed from (1) colics, e.g appendicular colic, biliary colic or intestinal colic, due to constipation or early enteritis (2) perforations, e.g of a gastric ulcer (3) acute pelvic disorders, e.g a twisted ovarian cyst. In typical cases the diagnosis is rarely difficult. If doubt exists, an enema should be given, and repeated after an hour The diagnosis is confirmed if the enema is returned clear and no flatus is passed. A straight X ray taken with the patient upright will reveal multiple fluid levels and may indicate the site of the obstruction

The cause of the obstruction can sometimes be determined, or at least guessed at, from the history or clinical examination. An old operation scar for example, suggests the likelihood of obstruction by adhesions (*Figs. 217 and 218*) In all cases the hernial orifices should be examined and the rectum palpated.



Fig 217 Visible peristalsis in a patient who for several days had had symptoms of partial intestinal obstruction. The scarring from previous operations indicates the probable obstructive agent—an adhesion (see Fig 218).



Fig 218. Obstruction of small intestine by an omental adhesion, the result of a former laparotomy (see Fig 217).

Treatment The obstruction must be relieved promptly by operation Operation should be delayed an hour or so, however or even considerably longer for certain essential preliminary measures. First a large enema should be given to confirm the diagnosis Then a naso-gastric tube is passed to empty the stomach and constant suction applied Finally, fluids (Ringer s solution and potassium replacement solution) must be given by the intravenous route to replace the lost fluids and electrolytes. Several litres may be required, according to the degree of dehydration present.

At operation if there is no indication of the site of obstruction a midline or right paramedial incision is made The cæcum is first examined If it is dilated the obstruction is sought in the colon and generally a colostomy or cæcostomy will be required If the cæcum is collapsed the ileum is traced upwards until the obstruction is found. It is then relieved or if this is impossible short-circuited

After operation gastric drainage and intravenous fluid replacement may be necessary for a few days.

Strangulation

In this condition occlusion of the lumen is accompanied by compression of the mesentery with venous congestion of the affected loop. Later the arterial blood supply may be impaired and gangrene of the loop result.

Causes. By far the commonest cause is strangulated hernia, external or internal Other causes are volvulus intussusception and mesenteric vascular occlusion

Pathological Features. Almost always there is a double occlusion of the lumen, e.g at the two ends of a herniated loop The closed loop

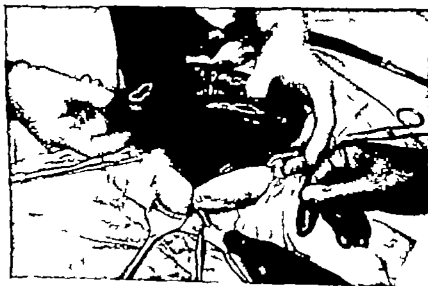


FIG. 219 Intestinal strangulation due to volvulus. The affected segment of ileum is non-viable.

becomes distended with gas from fermentation, and becomes deep purple from the intense venous congestion caused by strangulation. The mucous membrane soon ulcerates, blood is extravasated into the intestinal wall and pours into the lumen, and a sero-sanguinous fluid *exudes into the peritoneal cavity* After a variable time the arterial blood supply to the loop is impaired and *gangrene sets in, at first at the* two constriction rings, later over the whole loop Even before this occurs, infection leaks through the devitalised wall and leads to diffuse peritonitis.

Toxic Effects Severe collapse develops rapidly in intestinal *strangulation* *Partly this is due, as in simple occlusion* to loss of fluids and chlorides and absorption of depressor substance, but in addition the following two factors are of importance —

(1) The affected loop is in a state of marked venous congestion, and much bloodstained fluid is exuded into the wall of the loop and into its lumen In the case of a long loop this leads to a diminution of the circulating blood volume, and thus reduces the blood pressure.

(2) The content of the strangulated loop is highly infective and, when the wall becomes devitalised, bacterial toxins filter through into the peritoneal cavity and are absorbed thence into the circulation. This, it should be noted is one reason why strangulation of an external *hernia is less dangerous than one of an internal hernia, for there is less* absorption of bacterial toxins from the small hernial sac than from the main peritoneal cavity

Clinical Features The clinical features in strangulation are the same as in simple occlusion (p 407) except that the progress is more rapid and the toxæmia more profound. *The special features in such* conditions as volvulus and intussusception are described on the appropriate pages.

Treatment. The pre-operative treatment is the same as for simple occlusion except that in some cases blood transfusion is valuable.

At the operation, after the obstruction has been relieved, the loop of gut must be examined to determine if it is viable. This is decided by its appearance, colour and motility If plum coloured from venous stasis it is usually viable. Non viable intestine is grey and flaccid (sometimes compared to wet blotting paper) *and does not contract* when stimulated, nor does it transmit waves of peristalsis. If the gut is gangrenous, or even if there is doubt as to its viability the loop should be removed.

Sometimes it is necessary to remove several feet of the intestine This is particularly so where the *condition is due to* obstruction of the mesenteric vessels (usually due to an embolus carried from the left auricle in cases of mitral stenosis) In this particular condition anti coagulants must be given later to prevent recurrence.

The post-operative treatment is the same as *for simple occlusion.* In addition, an *antibiotic should* be given to combat the infection.

Paralytic (Adynamic) Ileus

This term is applied to conditions in which portions of the small intestine undergo paralysis and dilate, giving rise to a functional obstruction

The mildest type approximates to the common post-operative distension with "gas pains" and is probably due to segmental paresis of the intestine resulting from reflex nervous causes. It responds well to simple measures, such as hot applications and enemas

A more severe type is seen occasionally after any type of operation, particularly where there is much dehydration Potassium deficiency is believed to be the factor responsible The treatment is to remedy the defect by giving an intravenous infusion of potassium solution (see p 5)

The most severe type is associated with peritonitis and is seen most commonly after removal of a highly infected appendix. In this type the paralysis is probably due to the direct toxic actions of the peritoneal infection on the musculature of the ileum.

The affected ileum becomes hugely distended with gas and the copious fluid content is highly infective. The jejunum above being obstructed, undergoes retroperistalsis and thus vomiting of progressively more stercoraceous character develops The abdomen becomes distended and splashing may be elicited in the dilated loops of intestine

It is now recognised that danger to life in paralytic ileus arises mainly from three factors (1) The immense loss of fluids and electrolytes (2) bacterial toxæmia, partly from the original infection of the peritoneum and partly from the rapid growth of organisms in the content of the upper intestinal tract (3) distension of the stomach, which presses upon the diaphragm and thoracic organs and indirectly leads to pneumonia from aspiration of vomit into the lungs. Fortunately vigorous treatment directed to these factors will often bring about speedy improvement and recovery

The first step is to introduce a 7 mm. naso-gastric tube and institute continuous drainage of the stomach. Secondly the fluid and electrolyte balance is restored by copious intravenous infusion of Ringer's solution and potassium replacement solution Thirdly a wide-spectrum antibiotic must be given.

The later treatment is as for peritonitis (p 370)

CHRONIC INTESTINAL OBSTRUCTION

Chronic intestinal obstruction results most commonly from the gradual constricting effect of a carcinoma. Such a malignant string stricture occurs usually in the distal colon, less often in the proximal colon and rarely in the small intestine. Chronic obstruction may also result from a tuberculous stricture from peritoneal adhesions, or from adhesions within a hernia, e.g an umbilical hernia.

As a result of the obstruction the intestine proximally undergoes hypertrophy and becomes dilated Owing to infection of the stagnant

contents a stercoral ulcer may develop and may perforate, giving rise to a virulent diffuse peritonitis. A commoner complication is for the obstruction to become acute, owing to progressive narrowing of the stricture or to impaction of solid fæcal matter or a foreign body such as a fruit stone.

Clinical Features. A chronic obstruction gives rise to recurrent colicky pain, generalised over the abdomen to recurrent attacks of vomiting and to increasing constipation The abdomen becomes distended and borborygmi are often noted.

Examination reveals tympanitic distension of the abdomen and in many cases peristaltic waves are visible on careful inspection. In all cases the hernial orifices and the rectum should be examined

The diagnosis is confirmed and the site of obstruction defined by radiographic examination after a barium enema or meal.

The treatment varies according to the causal condition (see appropriate sections)

INTUSSUSCEPTION

This is an invagination of one part of the bowel into the adjoining part. It is a common disease in infants and may occur though rarely in older children and adults.

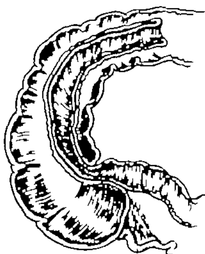


Fig. 220 Ileo-colic intussusception.

In infants intussusception results from irregular peristalsis, due to enteritis or a faulty diet in older persons some such lesion as a simple tumour or an inverted Meckel's diverticulum is generally responsible for initiating the condition

A fully formed intussusception consists of three layers of bowel, the entering and returning layers of the intussusceptum and the sheath or intussuscipiens The portion which first becomes invaginated constitutes the apex of the intussusception It is forced further and further along within the sheath, and may eventually reach the anus, or even protrude through the anus.

The following types of intussusception are recognised —

(1) Enteric, which is confined to the small intestine—a rare type, mainly seen in adults

(2) Ileo-colic, the common type in infants. It originates in the lower ileum, and the apex then passes through the sphincter into the colon and may eventually reach the anus

(3) Ileo-cæcal, in which the apex is formed by the ileo-cæcal valve.

(4) Colic, a rare form, mainly seen in adults, confined to the colon Since the colon is wide and lax the vessels are not acutely compressed and

no urgent symptoms develop Indeed, the condition may persist for several weeks.

Clinical Features. Intussusception occurs with rare exceptions in infants between six months and two years old The child is suddenly seized with violent colicky pain causing him to scream and draw up his knees The pain may last a minute or so and then after an interval recurs with increasing frequency The child looks pale during each attack, and shortly after the onset he vomits a little but at this stage there are no obstructive symptoms, and the only feature is recurring attacks of pain

The next sign is the passage of blood and mucus per rectum the so-called red-currant jelly stool due to engorgement of the invaginated intestine At this time also the obstructive phase begins vomiting becomes more and more marked, and the child becomes pale dehydrated and collapsed

On examination in the early stages, i e in the first twelve hours or so the abdomen is soft and lax, with no distension Palpation reveals the most characteristic sign, a sausage-shaped tumour At first the tumour is in the right iliac fossa, but it soon passes up under the right costal margin, then across the midline, and finally down the left side towards the pelvis. Later the swelling may be obscured by abdominal distension

On rectal examination in a late case the apex of the intussusception is sometimes palpable, and the examining finger will be found covered with blood and mucus.

Diagnosis. When a healthy infant screams with recurring colics, vomits a little, passes bloodstained mucus and presents a soft abdomen with a palpable lump the diagnosis is not in doubt. Intussusception may be distinguished from enteritis by the fact that after the first few hours the stool consists of blood and mucus only with no fæcal matter and no bile. Henoch's purpura may cause difficulty especially as it may be complicated by intussusception Generally however it occurs in older children and there may be other features, such as hæmarthrosis.

Treatment. The abdomen is opened by a small incision on the right side. Two fingers are then inserted and the intussusception reduced as far as possible while it lies in the abdomen. The most difficult part is to reduce the last inch or two and to do this the loop is withdrawn at the wound. Reduction should be effected mainly by squeezing the distal end of the sheath, rather than by pulling too vigorously on the invaginated portion. If reduction is impossible, a lateral anastomosis should be made between ileum and transverse colon. This is a dangerous procedure in a young infant, but less so than the alternative, resection of the affected segment.

VOLVULUS

A volvulus or rotation of intestine is prone to occur when a bulky loop of gut is suspended from a narrow mesenteric pedicle, especially

if the gut acquires a secondary attachment at its fundus, e.g by an adhesion, which acts as an axis for rotation.

Volvulus most often affects the pelvic colon, rarely the ileo-cæcal segment or the small intestine. A special type, affecting the whole *midgut loop, occurs in newborn infants*

Volvulus of the Pelvic Colon. The pelvic colon, suspended from its narrow mesentery is liable to volvulus, especially when overloaded with fæces as a result of chronic constipation. The actual rotation may follow a sudden muscular effort or a simple change in position

The two ends of the affected loop are occluded, and as a result the loop becomes distended by gas formed in the lumen. The distension is extreme and soon fills the greater part of the abdomen. The veins in the mesocolon are compressed, and as a result the ballooned gut becomes a deep purple colour while blood is extravasated into the gut wall and into the lumen, and a bloodstained exudate is poured into the peritoneal cavity

In mild cases the volvulus may be relieved spontaneously more often it proceeds to gangrene of the affected loop and to a virulent form of diffuse peritonitis

Clinical Features Volvulus of the pelvic colon occurs mainly in elderly men. *Often there is a history of previous mild attacks, or of* spasmodic pains relieved by the passage of flatus The onset is sudden with severe colicky pain, felt mainly in the left lower part of the abdomen and in the back. Often there is tenesmus, with a desire to empty the bowel, but neither flatus nor fæces can be passed Hiccup is an early feature, vomiting a late one.

On examination the striking feature is marked tympanitic distension, at first mainly in the left lower quadrant, later filling out the whole abdomen

The diagnosis is to be made from a carcinoma of the distal colon with obstruction The more acute onset, rapid *progress and greater* distension point to volvulus.

Treatment If enemas fail to bring relief the treatment is by operation. In view of the great risk of recurrence, the most satisfactory procedure is to resect the affected loop If the gut is gangrenous this treatment is imperative. If the gut is viable and resection not thought advisable, the loop should be deflated by guiding a rectal tube up into it, and the volvulus can then be untwisted.

Volvulus of the Ileo-cæcal Segment. This is a rare affection The symptoms resemble those of volvulus of the pelvic colon, but are usually not so acute. The treatment is to undo the twist and establish a cæcostomy

Volvulus of Small Intestine. This is especially apt to affect a dilated loop of intestine proximal to a tuberculous stricture, or a loop fixed by adhesions to the anterior abdominal wall. The symptoms are similar to those described above, except that vomiting occurs early and is profuse. Not infrequently there is a history of previous abortive attacks,

characterised by colic and some vomiting, the result of partial or in complete volvulus.

Volvulus Neonatorum. In early fœtal life the whole midgut (from the duodenal papilla to the region of the splenic flexure) is suspended from a single fan shaped mesentery attached to the posterior abdominal wall by a very narrow base. Normally the gut rotates as a whole through 300 degrees in the anti-clockwise direction In this way the duodenum assumes its C shape That part of the mesentery covering the mesenteric vessels and attaching the proximal colon then becomes fixed to the posterior wall and is obliterated

In rare cases the midgut fails to rotate and retains its fœtal state, with a simple mesentery slung from a narrow pedicle. It is then peculiarly liable to volvulus.

Volvulus neonatorum affects a healthy infant after a few days' normal existence. The intestine is occluded just below the duodenal papilla, and consequently the vomit, which is profuse, contains bile.

The diagnosis is to be made from congenital atresia, which is present from birth, and from pyloric stenosis which generally develops later (p 403) The treatment is to undo the twist by operation

FOREIGN BODIES IN THE INTESTINE

Gall-stone Ileus A large gall-stone, ulcerating its way from the gall bladder into the duodenum may give rise to intestinal obstruction when it arrives at the narrower reaches of the lower ileum. In most cases the obstruction is incomplete at first, as the stone alternately impacts and moves on Later it may become complete.

There may be a history of previous cholecystitis but often this is absent, and the symptoms may be simply those of a slowly-developing partial obstruction.

The diagnosis is to be made from vomiting due to cholecystitis, and from other forms of subacute or acute obstruction. The difficulty is increased if the patient is adipose, and especially if as is not uncommon, she also has an umbilical hernia. A simple radiograph may show the stone.

The treatment is to open the abdomen and remove the stone through a small incision in the intestine. The auxiliary therapeutic measures described on p 409 should also be applied. The mortality is high, mainly owing to delay in operating due to difficulty in diagnosis

Enteroliths. These are concretions formed in the intestine and composed of vegetable residues, hair fibrous matter fruit stones, insoluble drugs such as barium, and salts such as calcium phosphate and carbonate formed as a result of chronic enteritis. They give rise to recurring attacks of abdominal pain, vomiting and diarrhœa with blood in the stools. As the obstruction becomes more marked the vomiting increases and the abdomen becomes distended.

The diagnosis is to be made from other causes of recurring or chronic obstruction (p. 411) Radiography is useful, for many enteroliths are

partly opaque to X rays. The treatment is to remove the foreign body by operation

Faecal Impaction In debilitated old people with chronic constipation a mass of fæces may impact in the pelvic colon or rectum giving rise to subacute obstructive symptoms. The obstructive features are insidious in onset and rarely acute. The mass can be felt per rectum, and similar masses may also be felt in the abdomen and recognised by the fact that they pit on pressure. The treatment is by repeated enemas assisted if necessary by manual extraction of scybala impacted in the rectum.

INTESTINAL TUBERCULOSIS

Intestinal tuberculosis occurs in two forms either of which may be associated with tuberculous peritonitis or tuberculosis of mesenteric glands (p 381) Both forms are now rare.

Tuberculous Ulcers and Strictures. These lesions are caused by bacilli swallowed in infected sputum or milk. They are commonly situated in the absorptive region of the gut the lower ileum and they are almost always multiple.

The ulcers originate in the Peyer's patches of lymphoid tissue and they progress slowly with much fibrosis and in healing give rise to multiple strictures.

Often strictures and ulcers are present together and give rise to attacks of obstruction alternating with diarrhœa.

The treatment is by antibiotics and general measures Operation may prove necessary if obstruction becomes acute, when the affected segment of bowel may be short-circuited or resected.

Hyperplastic Ileo-cæcal Tuberculosis. In this rare condition the wall of the terminal ileum and cæcum is infiltrated with hyperplastic fibrous tissue, which obstructs the lumen and forms a palpable mass resembling a carcinoma.

The treatment is to excise the affected segment or if this is not feasible, to short-circuit it by anastomosing the ileum to the transverse colon.

REGIONAL ENTERITIS (CROHN'S DISEASE)

This is a non specific granulomatous lesion usually affecting the distal few inches of the ileum but occasionally the jejunum or even the colon, characterised by fibrosis and giant cell systems (resembling tuberculous follicles but without caseation) and secondary ulceration of the mucous membrane.

Occasionally the disease arises acutely with symptoms which closely resemble a mild attack of acute appendicitis At operation at this stage the segment of ileum is swollen, turgid and brightly inflamed, with swelling and fiery hyperæmia of the related mesenteric glands. Under such circumstances no treatment is indicated. The appendix, which is unaffected should on no account be removed, lest a fistula develop and all that is necessary is to close the abdomen. The symptoms rapidly abate and usually do not recur

More commonly the disease arises insidiously ulcers develop on the mucous aspect, the wall becomes fibrous and multiple strictures develop Fistulæ may develop between the ileum and the bladder or colon, or open at the skin surface. Peri anal sinuses and fistulæ also are common.

In the usual chronic type a mild persistent diarrhœa is a common feature, while later stricture formation may lead to constipation pain in the lower abdomen, and eventually a partial obstruction

On X ray examination after the barium enema the barium usually leaks through the ileocæcal valve which is incontinent and outlines the terminal ileum which is rigid and narrowed (Kantor s string sign)

Medical treatment by cortisone is sometimes useful Operation is required in the presence of obstruction or fistula If possible the affected segment is resected If it is too adherent the ileum is divided above the diseased segment, the lower end closed and the upper end implanted into the colon Recurrence may take place sometimes after many years.

ULCERATIVE COLITIS

This disabling disease, which occurs mainly in young adults, is characterised by the development of innumerable small ulcers in the mucous membrane of the colon especially the distal colon Its cause has been variously attributed to specific organisms such as streptococci, or to allergic influences.

The onset may be insidious or fulminating with a high temperature, severe toxæmia and rigors. Diarrhœa is severe and incessant, with loose highly offensive motions containing pus and blood Tenesmus is often a marked feature, and there is rapid loss of weight with severe dehydration and anæmia.

The disease pursues an irregular course with intermissions and relapses, and sometimes proves fatal after some months or a few years.

Complications are common including pericolic abscess, peritonitis due to leakage through the base of an ulcer and peri anal abscesses and fistulæ. In addition the great depletion of minerals proteins and vitamins may lead to cutaneous lesions, arthritis, neuritis and arterial occlusion If healing occurs, the colon is narrowed by multiple strictures.



Fig. 221 Ulcerative colitis. Portion of transverse colon, showing multiple ulcers and hæmorrhage.

The diagnosis is to be made from bacillary and amœbic dysentery pellagra, intestinal tuberculosis, diverticulitis and carcinoma of the colon. Radiography after a barium enema shows the colon as a stiff, irregular tube, completely lacking haustrations. The ulcers may also be visible, outlined by barium

A full bacteriological examination of the stools must be carried out, and blood cultures or the Widal test may also be required.

Sigmoidoscopy yields valuable information In the early stages the mucosa of the distal colon is seen greatly congested, spongy and hæmorrhagic, with innumerable small ulcers. Later the colon is rigid and resistant owing to fibrosis

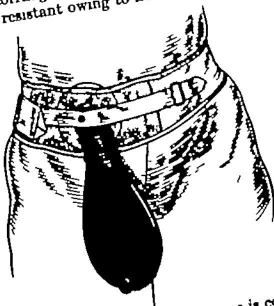


FIG. 222. Ulcerative colitis. Adhesive bag supported by light belt.

The treatment in mild cases is conservative The diet must be full but bland and non irritating Vitamin preparations are administered Intravenous infusions and blood transfusions are often needed In a proportion of cases steroid therapy by cortisone or prednisone is helpful

In severe or complicated cases it is necessary to perform an ileostomy and where possible this is accompanied or followed by resection of the colon The ileum is divided close to its termination and brought out through a stab wound a little to the right of and just below the umbilicus. If the general condition permits, the proximal colon or even the whole colon is resected Immediately after the operation a rubber bag with adhesive flange is fitted to collect the intestinal content. At first the watery fluid leaks out continuously but in time it tends to become less fluid and the inconvenience caused is small in comparison with the immense gain in general health

TUMOURS OF THE INTESTINES

Tumours of the Small Intestine

Simple tumours include adenoma, leiomyoma, fibroma and lipoma, which resemble each other closely in appearance and in effects. They

all tend to form smooth rounded tumours which become pedunculated They may give rise to chronic or recurring obstruction or may initiate an intussusception The treatment is to remove the tumour through an elliptical incision embracing its pedicle.

Malignant tumours include carcinoma and reticulo-sarcoma. They form single or multiple strictures and give rise to the symptoms of small intestine obstruction arising insidiously with recurring attacks of colicky pain, borborygmi vomiting and abdominal distension Ultimately the obstruction becomes acute. In some cases anæmia from recurrent blood loss is the predominant feature. In others, an acute perforation into the general peritoneal cavity occurs, with symptoms like those of a perforated ulcer In uncomplicated cases, a barium follow through examination may be helpful The treatment, in favour able cases, is to resect the affected part and re-establish continuity by end to-end anastomosis. If the tumour cannot be removed a short circuit may be performed to obviate obstruction.

Simple Tumours of the Colon

Adenoma, fibroma and lipoma occur though rarely They tend to become pedunculated and may cause recurring obstruction or give rise to a chronic intussusception.

Polyposis coli is a rare affection, often familial in incidence and important as a precancerous condition It is characterised by the development of a large number of pedunculated adenomata, perhaps fifty or a hundred or more, either scattered through the colon or limited to one part of it. The polypi may appear in childhood or early adult life The disease may be symptomless, but generally gives rise to pain and diarrhœa and anæmia from loss of blood Since carcinoma of the colon or rectum develops at an early age in a large proportion of sufferers from this disease, it is necessary to advise that the whole colon along with the rectum should be removed The patient is left with an ileostomy as in ulcerative colitis (p 417)

Carcinoma of the Colon

This common disease occurs mainly in patients over 50 years of age. The tumour is a columnar-cell adenocarcinoma, generally of scirrhous character It may occur in any part of the colon, but is most common in the sigmoid loop Two tumours may arise, simultaneously or in succession, in different parts of the colon. Multiple polypi may act as predisposing factors. In some cases there appears to be an inherited predisposition

Characteristically the growth is small and hard. It infiltrates and encircles the wall of the bowel, constricting it as by a cord (string stricture) and giving rise to progressive obstruction

Less often a different type of growth occurs, mainly in the cæcum. It forms a more massive tumour which ulcerates and bleeds and dis charges mucopus, but does not obstruct until late.

Spread of the Growth. Carcinoma of the colon is generally of slow

growth. Usually it spreads first to the regional lymph glands, and later it may involve adjacent viscera invade the peritoneal cavity and disseminate to the liver

(1) Lymphatic spread The distal colon has a scanty lymph drainage and consequently spread of the malignant cells is slow Glands *in the mesocolon close to the gut* are involved first, later glands alongside the inferior mesenteric vessels. The proximal colon, owing to its absorptive function has more copious lymph drainage, and consequently a carcinoma in this region spreads more rapidly first to the numerous glands along the ileo-colic and right colic vessels, and then to those along the superior mesenteric artery

(2) Direct infiltration may lead to involvement of the bladder small intestine or other viscera.

(3) Peritoneal spread is generally a late feature, characterised by the exudation of free fluid into the peritoneal cavity

(4) Liver involvement is usually late but may be early probably owing to chance invasion of a venous radicle by tumour cells

Complications. *Obstruction* is an almost invariable complication and in the common stenosing type in the distal colon it is the main feature of the disease The bowel proximal to the obstruction becomes hypertrophied and distended and the cæcum being capacious and thin-walled is ballooned

Stercoral ulceration may occur proximal to the growth or in the cæcum, owing to stagnation of the infective content.

Peritonitis may result from leakage of infection at the growth or from perforation of a stercoral ulcer

Pericolic abscess or cellulitis may arise from a similar cause.

Fistulæ may burrow into adherent structures, e.g into the bladder or small intestine The former complication leads to the passage of flatus and fæces in the urine

Clinical Features The symptoms vary somewhat according to the site of the growth. In carcinoma of the distal colon the first symptom in most cases is increasing constipation sometimes alternating with diarrhœa after large doses of aperient medicine. Pain may be felt on the left side of the abdomen Sometimes there is a considerable passage of blood by the rectum If the growth is low in the pelvic colon there may be tenesmus with passage of mucus and blood

As the obstruction increases pain begins to be felt, generally of colicky type and mainly on the left side of the abdomen. Flatulence adds to the discomfort, and sometimes borborygmi are felt. Eventually as the obstruction becomes more acute, the pain grows worse, the abdomen becomes distended, and vomiting begins. In atypical cases the early symptoms are not marked, and the first symptoms noted are those of subacute obstruction. In others, again, the first evidence is due to a complication, e.g a paracolic abscess.

In carcinoma of the proximal colon obstructive symptoms are not so prominent for the growth does not constrict the gut so readily and, moreover, the intestinal content is more fluid in character Rarely a

massive carcinoma of the cæcum causes no local symptoms, but gives rise to cachexia and anæmia, owing to infection of the growth and hæmorrhage from its ulcerated surface.

Diagnosis. A carcinoma of the distal colon is to be diagnosed from diverticulosis, chronic colitis and recurring volvulus and from simple chronic constipation a carcinoma of the proximal colon is to be diagnosed from chronic disease of the appendix or gall bladder or from ileo-cæcal tuberculosis. A non-obstructing growth in the cæcum must be diagnosed from carcinoma of the stomach and from primary anæmia

Radiography after a barium enema may show the growth as an irregular stricture, constant in successive films In an early case it is best demonstrated if the barium is evacuated and air introduced for residual flakes of barium then show a clear outline of the ulcerated area.



FIG 222. Carcinoma of the ascending colon. The barium enema has traversed the stricture, filled the cæcum and entered the distal ileum.

Radiography is unreliable for a growth in the lower part of the pelvic colon For this reason sigmoidoscopy should be performed as a routine if the X ray examination is negative.

Treatment. A carcinoma of the proximal colon is treated by resection of the terminal ileum, cæcum, ascending colon and hepatic flexure, with the blood vessels and glands draining this segment. If the growth cannot be removed, a palliative ileo-transverse colostomy is performed to short-circuit the growth. This operation is also done as a preliminary to the radical resection in the presence of severe obstruction.

A carcinoma of the distal colon is preferably treated by resection (colectomy) and end to-end anastomosis. The affected part is mobilised by dividing the peritoneal reflection on its *outer side*. The involved segment is then removed, with 3 inches or more of healthy bowel above

and below the tumour and with the corresponding part of the mesocolon and its contained glands. Sometimes the part removed extends from the transverse colon to a short distance above the pelvic floor Continuity is re-established by simple end to-end anastomosis

If the growth is too extensive to be removed, provided that its situation permits a palliative anastomosis is performed between the transverse colon and the sigmoid loop If however it is situated too far distal for this to be done, a palliative colostomy must be performed.

DIVERTICULOSIS AND DIVERTICULITIS OF THE COLON

Diverticula of the colon are formed by herniation of mucous membrane through weak areas in the muscular coat. They arise at the point of entry of blood vessels and are mainly situated between the tæniæ coli in close relation to the appendices epiploicæ They are



Fig 224. Diverticulosis of the colon. Numerous rounded shadows indicate the diverticula filled with barium. They are most numerous in relation to the descending and pelvic parts of the colon. Carcinoma at the pelvi rectal junction supervened in this case.

nearly always multiple, and are found most often in the sigmoid colon Their origin is generally attributed to increase in the intracolic pressure, due to spasm or constipation or injudicious purging

Infection of the diverticula (diverticulitis) is rare except in the sigmoid colon The affected segment of the gut becomes congested and rigid, infiltrated with inflammatory cells and thickened by œdema and

fibrosis. Eventually it shrinks to a rigid mass of fibro-fatty tissue the lumen being correspondingly constricted Abscesses may form and lead to paracolic suppuration or even to peritonitis. An abscess may burst into the bladder and lead to the discharge of fæces or flatus with the urine. Rarely the chronic irritation of the mucous membrane leads to the formation of a carcinoma.

Clinical Features The disease occurs mainly in middle-aged or elderly men Simple diverticulosis may be symptomless, whereas diverticulitis may have a variety of effects

In most cases the symptoms simulate carcinoma of the colon There is increasing constipation, with periodic attacks of diarrhœa. Blood and mucus may be passed in the stools. Pain is felt in the left iliac fossa, the abdomen becomes somewhat distended and ultimately subacute obstruction may develop

In other cases symptoms due to absorption of toxins constitute the main feature, e.g lumbago arthritis or spondylitis. In yet others the disease is brought to light by the development of a paracolic abscess or a fistula into the bladder

On examination, the thickened colon may form a tender palpable mass in the left iliac fossa, though often it is obscured by obesity or abdominal distension. The diagnosis is confirmed by radiography after a barium enema, which demonstrates the diverticula as rounded or flask like shadows related to the colon Further confirmation is provided by sigmoidoscopy

Treatment. The treatment generally is conservative. Paraffin or a paraffin agar preparation should be given and colon lavage may be advised Intestinal antibiotics are useful. If this treatment is ineffective, and if the disease is limited in extent the affected segment may be resected Alternatively a proximal colostomy may be performed. If a paracolic abscess forms it should be opened by an incision in the lateral part of the iliac fossa.

MESENTERIC VASCULAR OCCLUSION

Embolism and thrombosis of the superior mesenteric artery and vein constitute a rare disease, which occurs mainly in elderly persons. Generally the embolus is derived from a mitral vegetation or from a thrombus attached to an atheromatous plaque in the aorta. It usually blocks the main stem of the superior mesenteric artery Since the collateral circulation is ineffective in a sudden emergency the intestine undergoes infarction, the length affected varying from a few feet up to 14 feet or more. Owing to venous backflow along the valveless superior mesenteric vein, the affected segment becomes intensely congested and of deep chocolate colour Later the venous blood clots and gangrene sets in The wall and lumen of the gut are filled with extravasated blood, and a bloodstained exudate is poured out into the peritoneal cavity

The clinical features are generally those of a fulminating abdominal crisis, with vomiting abdominal pain and distension, melæna and

rapid collapse On examination the abdomen is tender and distended, and sometimes the swollen bowel is palpable

The treatment in suitable cases is to resect the affected segment of intestine. As long a segment as 14 feet has been removed successfully In most cases, however the general condition does not permit such heroic treatment. After successful operation, blood should be transfused to replace the blood lost in the congested loop Anticoagulants may be used to prevent extension of the clotting process.

FÆCAL FISTULA

An *external fistula* opening on the skin surface may communicate with small or large intestine If the jejunum is involved, the discharge is fluid, contains bile and undigested food is copious in amount, and causes marked irritation of the skin. If the ileum is involved the discharge is fluid of brownish colour and less irritating If the cæcum is involved, the discharge is fluid matter if the distal colon it is solid fæcal matter

An external fistula may be congenital, due to a patent vitelline duct (p 405) it may result from operative or other trauma, or it may be caused by disease. The diseases responsible include appendicitis with abscess formation, ileo-cæcal actinomycosis, ileo-cæcal tuberculosis, Crohn s disease, diverticulitis and carcinoma of the colon

The site, length and extent of the fistula may be determined by radiography after a barium meal or enema, or after injecting barium along the fistula.

The treatment in suitable cases is to deal with the cause, when the fistula will heal. In appendicitis the fistula generally closes spontaneously In tuberculosis, sanatorium treatment is indicated at first later the fistula may be dissected free and excised the opening being closed by sutures. In carcinoma or diverticulitis a colostomy should be performed at a higher level.

A fistula into the small intestine causes rapid wasting owing to loss of fluids and nutriment. In addition the skin round the fistula is excoriated and ulcerated by the digestive juices In such cases operation should be performed without delay The abdomen is opened through a separate incision and the intestine above the fistula is divided Continuity is re-established by anastomosing the upper loop to the ileum below the fistula or to the transverse colon

Internal fistula generally results from invasion of adjacent viscera by a carcinoma of the bowel. Thus a fistula may develop between the colon and small intestine, or the colon and bladder Rarely diverticulitis is responsible. In colo-intestinal fistula the only available treatment in suitable cases is to resect the growth along with the involved loop of small intestine, restoring the continuity by anastomosis. In colo-vesical fistula a colostomy should be performed to divert the fæces from the bladder

Colostomy A colostomy is performed most often as a palliative

procedure for carcinoma or other diseases of the distal colon or rectum, or as a preliminary to removal of the rectum.

If properly performed and cared for a colostomy causes very little trouble and inconvenience If not, it causes continual discomfort and misery

If the pelvic colon is used the incision may be through the left rectus muscle or an oblique muscle-splitting one may be made in the iliac fossa If the transverse colon is used the incision should usually be through the upper part of the left rectus

Whenever possible the abdomen should first be explored in the midline, and the colostomy performed through a small counter incision. In this way there is no risk of hernia alongside the colostomy or of prolapse of the gut.

When the colostomy is opened care must be taken to separate the afferent and efferent loops completely otherwise fæcal matter will reach the distal colon and cause irritation at the site of the growth.

In the after treatment an attempt must be made to secure a single-bowel movement at a regular time, e.g immediately after breakfast. With proper management, for the rest of the day it is only necessary to keep a thin layer of wool applied to the orifice, holding it in place by a corset or body belt. To achieve this regularity it is essential to avoid all laxatives, regulating the bowel by means of the diet. If all attempts to regulate the bowels fail, the patient may be taught to empty the colon by enema daily Only rarely should it be necessary to wear the old fashioned colostomy cup except as an additional precaution

Intestinal Cul-de-sac Loop Syndrome

Normally Vitamin B_{12} (cyanocobalamin) derived from food or intestinal bacteria, is absorbed from the small intestine and takes part in the maturation of red blood cells. In certain intestinal lesions its absorption is impaired, resulting in macrocytic anæmia. This may occur (1) where a considerable part of the small intestine is by passed, for instance after entero-anastomosis or jejuno-colostomy (2) where there is stagnation in a cul-de-sac such as a narrow mouthed diverticulum. It is thought that bacteria proliferating there either use up all the avail able B_{12} or produce a toxin which destroys it.

The condition is to be diagnosed from other severe anæmias. It is distinguished from pernicious anæmia by the presence of acid juice, and by the fact that a wide spectrum antibiotic such as tetracycline produces rapid, though temporary alleviation. The treatment is to correct the intestinal lesion by operation.

CHAPTER 36

THE RECTUM AND ANUS

Examination

ALL the common diseases of the rectum and anus can be diagnosed with some degree of exactitude by digital examination and this simple investigation should be carried out in every case with symptoms pointing to the lower bowel

Digital examination of the rectum may be performed with the patient leaning over a chair back, reclining in the semi prone (Sims) position or in the knee-elbow position. First the skin of the perineum and anus is inspected for signs of a sinus, a fistula external piles, or eczema. Next the gloved finger well lubricated is inserted into the rectum, traversing the anal canal very slowly to avoid pain If in spite of this care, pain is caused and if the sphincter is felt gripping the finger tightly a fissure should be suspected

At this stage the mucous membrane of the anal canal is palpated for evidence of an indurated fissure or of internal piles.

When the rectum is entered, the normal structures are palpated first—the prostate and vesicles in front, the hollow of the sacrum and coccyx behind In the female the cervix uteri can readily be felt, and should not be mistaken for a tumour The mucous membrane is palpated its mobility thickness and succulence estimated and next the finger is swept round in search of any abnormal swelling e g a polypus or a carcinoma. In the average case a lump within 3 or 4 inches from the anus can be palpated and, if the patient is told to bear down, the bowel can be sleeved over the finger and a further inch or more added to the range of examination Care must be taken not to mistake a hard scybalous mass for a growth. Finally when the finger is withdrawn, any colon content adhering to the tip should be examined for blood or mucus

Proctoscopy and sigmoidoscopy should be carried out in all doubtful cases The proctoscope is a tubular speculum, electrically lighted, which may be inserted a few inches into the rectum The sigmoidoscope is similar but 12 inches in length, and can be inserted as far as the pelvic colon. The patient may be in the Sims or the knee-elbow or the lithotomy position The instrument is well lubricated and inserted very gently bearing in mind that the direction of the anal canal is approximately towards the umbilicus. When the rectum is entered the obturator is removed and the interior of the gut may be inspected

IMPERFORATE ANUS

The rectum and anal canal are developed from different sources and at first are quite separate. The rectum is derived from the hind-gut, while the anal canal is derived from a skin depression known as the proctodæum and in early fœtal life the two are separated by the cloacal or anal plate. This

thin membrane breaks down in the third month of intra-uterine life, and the continuity of the bowel is then completed

In imperforate anus the rectum and anal canal remain separated. The following varieties are recognised —

(1) The rectum and anal canal are separated by a thin membrane which bulges with meconium when the child cries The treatment is to divide the membrane and keep the passage dilated by bougies

(2) The anal canal is entirely deficient and the rectum ends blindly in the pelvis The treatment is to bring the pelvic colon to the surface as a colostomy

(3) The rectum opens by a fistula into the vulva or rarely the vagina bladder or urethra. In this type of case there are no urgent symptoms and treatment should be delayed until the child is fit to stand the major operation necessary to correct the deformity

INJURIES TO THE RECTUM

The rectum may be injured by such injuries as a fall on a railing spike or by the pressure of the fœtal head during parturition Rarely injury is caused by the careless introduction of an enema nozzle or by forcible inflation.

In the former type of case there may be no external wound and the nature of the injury may escape recognition. There is severe shock, pain is felt in the perineum and pelvis and in most cases there is haemorrhage from the rectum. If the injury is untreated pelvic cellulitis and peritonitis are very apt to follow and to prove fatal

The treatment is to open the abdomen and suture the wound in the rectum. If the wound is inaccessible, colostomy should be performed to reduce the risk of infection.

FOREIGN BODIES IN THE RECTUM

Foreign bodies in the rectum include (1) objects swallowed e.g fish bones coins etc. (2) intestinal matter e.g hard scybala enteroliths gallstones (3) objects introduced through the anus

A foreign body in the rectum gives rise to pain and tenesmus with passage of blood and mucus A large object may cause frequency of micturition or press upon the sacrum and cause pain referred to the back and thighs It may predispose to ischiorectal suppuration and lead to a fistula.

The treatment is to remove the foreign body If necessary the sphincter may first be stretched preferably under spinal anaesthesia.

STRICTURE OF THE RECTUM

A stricture of the rectum may follow any type of ulceration and may occur as a sequel to technical errors in the removal of haemorrhoids. Stricture of the rectum also commonly results from malignant disease in this situation.

Apart from such cases in which the ætiology is clear there is another type of stricture of obscure origin. This type occurs almost always in women and is characterised by an insidious onset and slow progress The stricture is associated with ulceration of the rectum and extensive fibrosis of the extra-rectal tissues. The greater part of the rectum may be involved and ultimately its lumen may be reduced to a narrow tortuous channel.

This type of stricture was formerly ascribed to gonorrhœa or syphilis It is now recognised that whilst a small proportion of cases are due to these diseases or to tuberculosis the majority are due to the virus of lymphogranuloma inguinale (p 101) and give a positive Frei's test

The symptoms are those of progressive difficulty in defæcation Incontinence of fæces may develop. In the late stages subacute obstruction may supervene.

The treatment in most cases is by repeated dilatation with graduated bougies The dilatation should be performed with great care owing to the risk of pelvic cellulitis or peritonitis from splitting the rectal wall. A tight

fibrous stricture may be nicked in several places with a knife and later dilated. If the stricture is long and tight, and especially if ulceration is still active, a colostomy should be performed.

PERINEAL SUPPURATION

Peri anal Abscess. This is a simple subcutaneous abscess caused by infection entering from the skin or from an anal fissure. It forms a localised painful swelling close to the anus It does not involve the anal sphincters or the rectum in any way and generally it subsides quickly after the pus is evacuated The treatment is to open it through a small incision radial to the anus

Boils in the Perineum. The perineum is a common site for boils which are caused by a staphylococcal infection gaining access at one of the skin glands or hair follicles The boils are often multiple and tend to recur They cause agonising pain especially on walking or sitting and lead to considerable malaise with slight pyrexia.

The treatment is the same as for boils in other sites (p 49)

Submucous Abscess This rare type of suppuration is a simple abscess under the mucous membrane of the rectum generally due to infection from a fissure or erosion There is a small tender pocket of pus which is palpable on digital examination The treatment is to incise the overlying mucous membrane under direct vision through a speculum

Ischio-rectal Abscess. This is a deep-seated suppuration in the fat of the ischio-rectal fossa. In the great majority of cases the infection is derived from the rectum gaining access through a fissure, an ulcer an infected crypt, or a wound caused by a foreign body (e.g fishbone) Much less commonly the infection is from other sources, e.g the broad ligament, bladder prostate, or even an appendix abscess tracking down from the pelvis.

In the common type of infection derived from the rectum the organisms concerned are streptococci and coliform bacilli, sometimes accompanied by gas forming anaerobes.

The infection starts abruptly with a rigor The temperature is raised, perhaps to 101 or 102 F and considerable toxæmia is manifest. Pain severe and of throbbing character is felt deep in the perineum to one side of the rectum. At an early stage examination may reveal little change but a deep tender induration in the ischiorectal region, best palpated with a finger in the rectum If the abscess is allowed to progress the whole region between the anus and the buttock becomes swollen, hot, indurated and agonisingly tender Fluctuation is of late appearance. Ultimately the abscess is very apt to burst in two directions, at the surface and into the anal canal between the internal and external sphincters This is the common mode of formation of a fistula in ano

The treatment is to incise the swelling as soon as possible, even though no fluctuation is evident. A cruciform incision should be used, the long limb being 3 or 4 inches in length, running *antero-posteriorly* across the summit of the swelling the small incision transversely from the margin of the sphincter laterally The pus may be foul smelling grumous and hæmorrhagic. It is *evacuated and the wound packed* wide open. Antibiotics are administered

Tuberculous ischiorectal abscess is not uncommon Usually it arises somewhat insidiously, taking a week or more to develop, and causes little pain Less often, owing to the access of a mixed infection, it runs an acute course very similar to the common type of ischiorectal abscess. The treatment is to open the abscess widely and pack it. Subsequently the fistula, which almost inevitably results, will require treatment (see below)



FIG. 223 Rectal fistulæ and abscesses. (*a*) Complete fistula in-ano. (*b*) External fistula. (*c*) Pelvi-rectal abscess. (*d*) Ischio-rectal abscess.

Pelvirectal Abscess. This is really a form of pelvic cellulitis and has no primary connection with the rectum. It is situated in the pelvis above the level of the levator ani muscle and is commonly derived from infections of the broad ligament prostate bladder or appendix, or from osteomyelitis of the pelvic bones

The clinical features at first are those of a pelvic cellulitis with pain and rigidity in the lower abdomen and frequency of micturition. As the abscess gravitates towards the rectum diarrhœa develops with tenesmus and passage of blood and mucus

In most cases the abscess bursts into the rectum and the symptoms promptly subside. Less commonly it gravitates through the levator ani muscle and reaches the ischiorectal fat, giving rise to an ischiorectal abscess. In such cases the treatment is as described above After the pus has been evacuated the deep track should be drained.

ANAL AND RECTAL FISTULA

Complete Fistula-in-ano. The common type of fistula in the anal region occurs as a sequel to an ischiorectal abscess that has burst in two directions, and it has an external orifice at the skin surface and an internal one in the anal canal. Such a fistula is prevented from healing by the movement to which the part is subject and by re-infection from

the rectum. In a considerable proportion of cases the fistula originates in a tuberculous ischiorectal abscess and its lining membrane of tuberculous granulation tissue prevents healing

The fistula forms a tortuous track often communicating with side channels and cavities filled with pus. In the course of time the surrounding tissues become very fibrous and indurated

The treatment is by operation To ensure permanent cure it is essential to lay open the whole length of the track and all side channels, and to pack the wound wide open so that it heals from the bottom by granulation In most cases a single-stage operation suffices. A probe

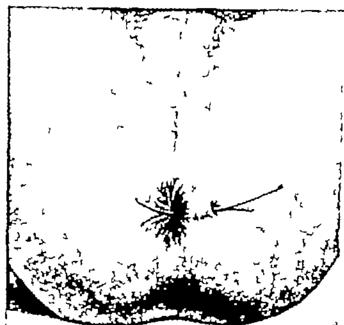


FIG. 226. Fistula in-ano. A probe has been inserted preparatory to laying the whole track open.

is passed along the track and bent so that its end protrudes through the anus, and all tissues superficial to the track are then divided by cutting down on the probe. If possible, the indurated wall of the track should be removed The wound should be packed open with no sutures.

In the case of a deep fistula involving both sphincters, a two-stage operation should be carried out to avoid the risk of incontinence The outer part of the track is dealt with first, and when it is healed the sphincters are divided By this time the healing fibrous tissue prevents the cut muscle fibres from retracting too far and the sphincteric control is preserved.

In the case of multiple extensive fistulæ the best treatment is to perform a temporary colostomy

External Fistula. This is formed by an ischiorectal abscess that has burst in one direction only There is a blind sinus, opening an inch or two from the anus, sometimes communicating with an abscess pocket. The treatment is to excise the whole track, or failing that, to open it widely and pack the wound.

Internal Fistula This is a track formed by an abscess that has burst into the anal canal or rectum alone. It is a rare condition, and in most cases requires no treatment. If necessary, it may be dilated and packed

Rectovaginal Fistula A fistulous communication between the rectum and vagina may be caused by injury during childbirth, or it may result from ulcerative colitis or malignant disease involving the rectum.

The fistula allows fæcal matter and mucopus to escape incontinently at the vulva.

The diagnosis is made on digital examination The treatment varies in traumatic cases an attempt may be made to close the fistula, while in other cases a colostomy should be performed

Rectovesical Fistula. A fistulous communication between the rectum and bladder generally occurs as a complication of diverticulitis or carcinoma of the pelvic colon or rectum In most cases an abscess develops first and ruptures into both viscera.

Flatus and fæces gain access to the bladder and are passed in the urine, but in spite of this gross contamination of the urinary tract the fistula causes no urgent symptoms. The treatment is to divert fæces from the fistula by performing a colostomy

PRURITUS ANI

This troublesome affection is characterised by annoying and sometimes well nigh intolerable itching at the anus and in the peri anal region. It is especially severe immediately after retiring to bed. On examination, there may be little to note but generally the skin round the anus is thickened rough and sodden, with superficial cracks of the epidermis. In late cases a frank dermatitis may be present.

Causes. In most cases pruritus is caused by an irritating discharge, the result of some local lesion such as hæmorrhoids fissure, fistula, proctitis, excessive sweating

In a few cases threadworms are responsible for the irritation.

In the remainder no obvious cause can be found and the condition may be attributed to some general disease, e.g diabetes or rheumatism, or to allergy Possibly in some cases the pruritus is caused by venous congestion, due to backflow through the plexus between the internal and external hæmorrhoidal veins.

Treatment. Many forms of treatment are advised a sure indication that none is entirely adequate.

(1) In mild cases it suffices to keep the part clean using a sponge after defæcation, and to apply a simple ointment.

(2) Any local lesion should be treated. Hæmorrhoids, if present, should preferably be injected.

(3) Threadworms should be sought by inspection of the anus, by proctoscopy or by a diagnostic enema of 4 oz. of normal saline given at a time when the pruritus is active. If threadworms are found the

treatment is to give a small enema of 5 per cent. sodium chloride solution each evening Careful personal hygiene is necessary to prevent re-infection

(4) An oily anæsthetic solution (10 ml. of. A.B.A. or percaine-oil, p 486) may be injected into the subcutaneous tissue of the peri anal region, encircling the pruritic area. The effect is to anæsthetise the sensitive region and to induce fibrosis.

(5) The perineum may be exposed to soft X rays.

(6) Ball s operation may be performed It consists in making a curved incision to either side of the pruritic area and elevating the skin flaps towards the anus in order to divide all sensory nerves.

PILONIDAL SINUS

This is a sinus of developmental origin in the post anal region. It has no connection with the rectum or anus but is apt to be mistaken for an anal fistula, and for this reason it can conveniently be described in this chapter

The sinus opens at the skin surface in the midline near the tip of the coccyx. The track passes up subcutaneously in the midline, and ends blindly behind the sacrum. The track is lined by squamous epithelium and often contains a nest of hair (hence the name pilonidal)

The sinus is believed to result from indrawing of ectoderm, due to traction upon the skin by the retrogressing tail bud. Others believe it is akin to barber s sinus in the finger webs, and due to hair forced under the skin surface by the movements of opposed skin surfaces. In some cases the orifice closes and the channel becomes dilated with glairy fluid to form a cyst, the post anal dermoid

The diagnosis is made from an anal fistula by the midline situation of the orifice and the direction of the track.

If causing much discomfort the whole track should be excised widely The wound commonly becomes infected and breaks down, and for this reason many surgeons prefer to leave it packed open to granu late. In either case the convalescence is prolonged.

HÆMORRHOIDS (PILES)

This term includes internal hæmorrhoids, which arise in the upper part of the anal canal, and the relatively unimportant external hæmor rhoids which arise under the skin at the anal margin.

Internal Hæmorrhoids

Internal hæmorrhoids result from dilatation and varicosity of the veins of the anal canal These vessels, which lie immediately deep to the mucous membrane, pass upwards in the wall of the rectum and ultimately converge to form the superior hæmorrhoidal vein Below they anastomose at the anal margin with tributaries of the inferior hæmorrhoidal veins.

Internal hæmorrhoids appear as rounded vascular dilatations covered with thin mucous membrane. In most cases there are three main pile masses, one situated anteriorly, the others postero-laterally As the internal hæmorrhoids enlarge they may implicate the lower part of the anal canal and become partly covered with skin (intero-external piles)

Causes. (1) In most cases the cause is chronic constipation Scybalous masses in the rectum press upon the veins in the rectal wall and lead to venous stasis, while straining at stool distends the ill supported veins in the anal canal and causes the piles to prolapse.

(2) Any mass in the pelvis e.g a tumour or a pregnant uterus, compresses the veins and thus predisposes to hæmorrhoids



Fig. 227 Strangulated piles. One large pile mass arising from the anterior wall of the anal canal is swollen, ulcerated and partly necrotic.

Clinical Features Bleeding is the first sign in most cases. The bleeding occurs on defæcation and the blood is bright red in colour In severe cases bleeding may occur at other times too

Prolapse of the pile occurs early The patient will state that the pile comes down during defæcation. At first it returns into the anal canal spontaneously when the patient ceases to strain Later it requires to be replaced manually In severe cases the piles prolapse on the slightest exertion.

Discharge of mucus commonly occurs and may lead to pruritus.

Pain is not a common symptom of piles It is much more characteristic of a fissure.

Complications (1) Profuse repeated hæmorrhage may lead to severe anæmia. (2) An "acute attack of the piles" may occur In this condition the piles prolapse and are gripped by the external sphincter The veins are compressed, the piles become engorged and swollen, and often become thrombosed and infected they may become ulcerated and even completely necrotic (Fig 227)

Diagnosis. It is important to remember that the patient's own

diagnosis of "piles" is often erroneous for to the laity every lesion in the anal region goes under this generic title. A complaint of "piles" may mean a fissure, a fistula, or even a carcinoma of the rectum. For this reason it is essential in every case to carry out a proper examination, and if this is done the diagnosis should present no difficulty. First the anus should be inspected for external piles. The patient should then be instructed to strain as if defæcating in order to protrude the internal piles. Finally the finger must be inserted into the rectum to exclude other lesions, e.g. prostatic enlargement or a carcinoma of the rectum. The piles can usually not be felt. If thought advisable they may be viewed through a proctoscope.

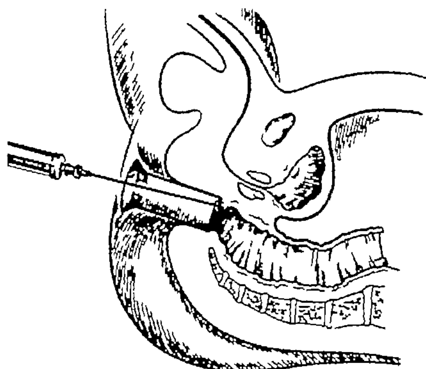


FIG. 226 Injection treatment of hæmorrhoids.

Treatment. (1) In mild cases and for piles in pregnancy or those due to liver cirrhosis, etc., palliative measures suffice. Constipation must be corrected by administering a lubricant, e.g. liquid paraffin or a preparation of paraffin with agar agar. An ointment may be applied to the anus. A bland suppository may be used.

(2) In prolapsed, infected piles the patient should be put to bed the foot of the bed raised, and wet dressings of eusol, lead and opium, or ichthyol in glycerine, applied. Treatment by injection or operation should be delayed until the infection has subsided.

(3) Injection treatment is valuable for small piles, especially in cases of bleeding piles. It is unsuitable for large prolapsing piles or for external piles, and should never be advised in the presence of infection.

The technique is simple and no anæsthesia is required. With the patient in the semi prone (Sims') position a speculum is introduced

into the rectum and then withdrawn until the pile is just visible. The injection is made deep into the pile, taking care to insert the needle well above the muco-cutaneous line.

The solution most often used is 2 to 3 ml of a 5 per cent. solution of phenol in almond oil. No special after treatment is needed and there should be no pain One pile should be injected at a time Subsequent injections may be made at weekly intervals

(4) Operation is indicated for piles unsuitable for injection It may be performed under general or spinal anæsthesia. The customary procedure is to dissect up the individual pile masses, ligate the pedicle thus formed, and remove the pile Other operations, e.g the cautery operation and Whitehead's excision of the pile-bearing area, have fallen into disfavour

External Hæmorrhoids

External hæmorrhoids arise at or just outside the anus, and take the form of small tender swellings covered with skin. In some cases they are caused by venous dilatation of small tributaries of the inferior hæmorrhoidal veins in others they are mere skin tags If the symptoms demand it, the treatment is by operation

Acute thrombotic pile results from rupture of the vein of an external pile, and is generally caused by a strain e.g in passing a constipated stool There is a sudden severe pain to one side of the anus, and inspection reveals a tense tender swelling the size of a cherry covered by thin skin, through which the purplish colour of the blood clot is faintly visible. If untreated, the pain slowly subsides and the pile becomes fibrotic, unless infection supervenes. The treatment is to turn out the hæmatoma under local anæsthesia.

ANAL FISSURE

This is a common condition, and is the most important cause of severe anal pain. It starts as a simple crack of the mucous membrane of the anal canal, and is generally caused by overstretching the canal in the act of passing a large scybalous mass In some cases the fissure is caused by the tearing down of one of the anal valves

The fissure is generally situated in the midline posteriorly In the course of time it deepens and its margins become indurated A tag of skin develops at the lower end the so-called sentinel pile, and this, being torn at successive defæcations, delays the healing of the fissure.

Symptoms. Pain is the main feature and is highly characteristic. The pain comes on during defæcation and may persist for half an hour or more after The pain is of an intense tearing or cutting nature, and is so acute, that the patient, usually a woman, dreads defæcation and subsequently becomes more and more constipated. In severe cases the pain is also referred to the abdomen, while the resulting constipation may lead to pain in the lumbosacral region.

Other symptoms are hæmorrhage during defæcation, discharge of mucus from the anus, and pruritus ani

Signs. On inspection, the sentinel pile may be visible, and it may be possible to expose the lower end of the fissure by gently parting the margins of the anus

On digital examination, the sphincter ani is found in a state of extreme spasm This spasm is the main cause of the pain, and also is the main factor preventing healing of the fissure

Digital examination is extremely painful, even with the greatest care It must be carried out, however in order to exclude other lesions within the rectum In some cases the indurated bed of the fissure is palpable.

Treatment. (1) A mild fissure of recent origin may respond to palliative measures—administration of paraffin with agar-agar application of a soothing ointment, use of a bland suppository before defæcation

(2) If these fail, an oily anæsthetic solution may be injected with the object of relieving sphincteric spasm. Two solutions are in common use (*a*) A.B.A. —3 per cent. solution of anæsthesin with benzyl alcohol 5 per cent. and ether 10 per cent in olive oil (*b*) 0 5 per cent. percaine with benzyl alcohol 10 per cent. and phenol 1 per cent. in olive oil. From 5 to 10 ml of the solution is injected on either side deep into the sphincter ani. The effect is to relax spasm, and thus to relieve pain and promote healing

(3) In most cases operative treatment is advisable, under general or spinal anæsthesia. First the anal sphincter is thoroughly dilated so as to admit three or four fingers into the rectum. This procedure prevents post-operative spasm Then the fissure is excised, with its indurated bed and a large triangle of skin including the sentinel pile Subsequently spasm of the sphincter is prevented by repeated dilatation with a bougie

PROLAPSE OF THE RECTUM

A partial prolapse of the rectum protrudes an inch or so from the anus and consists of mucous membrane only a complete prolapse may protrude several inches and consists of all the coats of the rectum. In severe cases it drags down a cul-de-sac of peritoneum from the pouch of Douglas.

Prolapse of the rectum occurs most often in children and in elderly persons. The predisposing factors are as follows —

(1) Laxity of the anal sphincters and the perineal supporting tissues, resulting in most cases from malnutrition or wasting disease.

(2) In women, perineal tears and prolapse of the uterus.

(3) Excessive straining due to constipation, diarrhœa, piles, worms, a tumour of the rectum or difficulty in micturition.

Clinical Features. At first prolapse is small and returns spontaneously later it tends to enlarge and may require to be replaced manually If allowed to remain protruded it becomes inflamed and may ulcerate. The infection may then spread through the rectal wall and involve the peritoneum.

The diagnosis is to be made from an intussusception by the comparatively mild symptoms and by the fact that the outer layer of the prolapse is continuous with the skin at the anal margin with no intervening recess as in an intussusception

Treatment. *In Children* To reduce the prolapse the child should be held up by the heels, and the protrusion gradually directed back into place by pressure with a pad of gauze The buttocks then should be strapped together over a large pad Any predisposing factor such as constipation, diarrhœa worms, phimosis, should be treated If



FIG. 229 Prolapse of the rectum in a boy aged eight, who had suffered from recurrent diarrhœa due to enteritis.

these measures do not suffice, the injection treatment is valuable, 5 per cent. phenol in almond oil being injected into the submucous coat to induce fibrosis. Four injections, each of 1 ml., are made at various points round the rectum as high as possible.

In Adults (1) Reduce the prolapse by gentle pressure. Raise the foot of the bed and strap the buttocks over a gauze pad

(2) If hæmorrhoids are responsible, they should be treated by operation. This generally cures the prolapse

(3) In severe cases proctopexy may be performed Various different types of operative technique have been advised. None is entirely satisfactory

SIMPLE TUMOURS OF THE RECTUM

Adenoma of the Rectum Rectal Polypus. This tumour is commonest in children, though it may occur in adults. It is a small rounded tumour red and vascular and usually about the size of a raspberry It is very apt to become pedunculated, and may protrude at the anus.

The tumour gives rise to bleeding from the bowel and to rectal irritation. If it protrudes from the anus it may be mistaken for a pile.

The diagnosis is readily made on digital examination if the finger is swept round the rectum so as to hook up the pedicle. It is distinguished

from a malignant growth by its mobility and lack of induration. In adults it may become malignant or may accompany a carcinoma.

The treatment is to ligate the pedicle and remove the tumour

Multiple polypi arise occasionally in children as a familial condition in association with polyposis coli a condition in which part or the whole of the colon may be studded with innumerable papillary adenomata. Often this condition is precancerous

Papilloma of the Rectum. This rare growth is of villous character and may spread quite extensively round the rectum. The treatment is to excise it.

Papilloma of the Anus. This is a squamous papilloma growing from the skin at the anal margin It forms a warty growth, often pedunculated The diagnosis is to be made from a pile and from venereal warts. The treatment is to excise the tumour

CARCINOMA OF THE RECTUM

This common tumour may take the form of an ulcerative lesion, which spreads round the rectum and gradually constricts it, or a large mass which projects into the cavity of the bowel. The latter is most commonly found in the capacious ampulla of the rectum



FIG 230 Rectal polypus in a man aged 78, who for over a year had suffered from what he regarded as a bleeding pile.

The growth spreads to a limited extent in the wall of the rectum It then spreads by the lymphatics, first to glands in close relation to the rectal wall later to those alongside the superior hæmorrhoidal vessels and in the base of the pelvic mesocolon. In some cases it involves adjoining structures, especially the base of the bladder or it may spread to the peritoneal cavity The liver is generally involved at a late stage, but occasionally early

Symptoms. The classical symptoms of carcinoma of the rectum are seen only in the late stages. They include alternating constipation and diarrhœa, tenesmus, pain in the rectum and sacrum, loss of appetite and loss of weight. It is never justifiable to delay surgical treatment

until such symptoms appear. In the early, curative stages the following symptoms occur:—

(1) Slight "diarrhœa"—a spurious diarrhœa due to irritant discharge from the growth—often most marked in the morning on rising.

(2) A feeling of incomplete emptying of the rectum on defæcation.

(3) Occasional passage of blood at defæcation.

Pain is absent until a late stage unless the growth is in the lowest part of the rectum. Eventually pain, constant irritation, infection and loss of blood lead to marked cachexia. In some cases a constricting growth gives rise to intestinal obstruction.

Diagnosis. The patient will often attribute his symptoms to piles but this ready-made diagnosis must never be allowed to stand in the way of a proper digital examination. When this is done the true diagnosis is made with ease by palpation of the indurated, stony hard mass. In a doubtful case the growth may be inspected through a proctoscope and a portion removed for microscopic examination.

In making the rectal examination the size and extent of the growth and its fixity to adjoining structures must be determined. Examination should also be carried out for growths in the liver and for free fluid in the peritoneal cavity.

Treatment. Operation should be advised in all except very late cases. If the growth is discovered at an early stage, radical operation offers a good prospect of complete cure. A single-stage combined abdomino-perineal resection may be performed. The abdomen is opened and explored. The pelvic colon is divided at a suitable level and the upper end brought out as a colostomy. The lower end is dissected down and tucked below the pelvic peritoneum, after which the abdominal wound is closed. The rectum is then exposed by an incision in the perineum, dissected clear and the whole length of gut removed. Alternatively the perineal part of the operation may be performed before the abdomen is opened.

Conservative resection of the rectum, with preservation of the anal sphincter, is generally unsatisfactory.

Colostomy may be required as a preliminary to the radical operation, especially if partial obstruction is present. A colostomy may be performed in late cases as a palliative procedure, to relieve tenesmus and prevent obstruction. Radium is of no value.

CARCINOMA OF THE ANUS

This uncommon growth is a squamous epithelioma, which starts at the anus and spreads outwards, involving the skin of the perineum. At an early stage it becomes ulcerated and gives rise to a bloodstained discharge. It metastasises to the glands in the groin.

The growth often causes a considerable amount of pain, and cachexia results from loss of blood and infection of the ulcer. The diagnosis

is made without difficulty on simple inspection. If necessary, a portion of the margin of the growth may be removed for microscopic examination

The treatment is to perform a colostomy and in an early case to follow this by a radical excision of the growth. In later cases radium is useful

CHAPTER 37

THE BILIARY TRACT

RUPTURE OF THE LIVER

This severe injury commonly results from industrial and road accidents. The rupture generally involves the convexity of the right lobe, and may be extensive. Often there are other injuries, e.g. ruptured spleen fractured ribs, fractured spine.

There is severe shock and later the signs of internal hæmorrhage develop Abdominal examination reveals tenderness and rigidity in the right upper quadrant, and there may be dullness on percussion above the pubes and in the flanks, due to blood in the peritoneal cavity If the patient survives, jaundice develops in a few days.

The treatment is to open the abdomen and arrest the hæmorrhage, often a task of great difficulty and danger The first step is to locate the source of the hæmorrhage and to exclude other injuries, such as rupture of the spleen. To arrest the hæmorrhage temporarily a finger may be hooked through the foramen of Winslow to control the hepatic artery and portal vein The rupture is then brought into view if necessary by enlarging the incision and any large vessels may be under run with silk sutures. The raw surfaces of the liver are then opposed by deep mattress sutures of catgut, and finally the edges are brought together by interrupted sutures. In difficult cases it may be necessary to pack the site of rupture in order to arrest the bleeding The pack may need to be left *in situ* for several days. In all cases shock must be treated and blood transfusion may be required both before and after operation.

AMŒBIC (TROPICAL) ABSCESS

This is a complication of amœbic dysentery The amœbæ are carried in the portal blood stream to the liver and there give rise to an abscess. The abscess is generally situated in the right lobe. It enlarges slowly and may eventually contain several pints of chocolate-coloured pus.

The symptoms are insidious in origin with "liverishness" indefinite pain in the right upper quadrant, loss of energy and loss of weight Later the temperature is elevated and there may be rigors and much sweating Examination reveals enlargement of the liver and elevation of the right half of the diaphragm with corresponding dullness at the base of the right lung

The treatment is by administration of emetine. Rarely if the abscess is large, it should be aspirated and emetine injected into the cavity Open drainage is indicated only if secondary infection supervenes.

PYLEPHLEBITIS

This rare disease generally follows appendicitis. It is characterised by the formation of multiple abscesses in the liver as a result of suppurative phlebitis spreading along the appendicular vein to the portal vein Possibly in some cases the infection is carried by septic emboli in the portal blood stream (portal pyæmia) In rare cases pylephlebitis occurs as a complication of other abdominal suppurations

The symptoms of pylephlebitis generally arise a few days to a week after

operation for a gangrenous appendix There is pain spreading up towards the liver with rigors and a high remittent temperature Signs of severe toxæmia are present. Abdominal examination reveals tenderness and enlargement of the liver Later a tinge of jaundice may appear

The treatment is to give full doses of antibiotics If the organism is sensitive, rapid cure may be achieved Other forms of treatment are in effective.

HYDATID DISEASE OF THE LIVER

Hydatid or echinococcus disease is due to infestation with the ova of the *Tænia echinococcus* Normally this parasite completes its cycle of development in two hosts the dog and either the ox or sheep The tænia is a tapeworm of four segments about ¼ inch long and is found in the intestine of the dog Ova liberated from its terminal segment contaminate pastureland and are swallowed by the ox or sheep On reaching the stomach the ovum penetrates the tissues and is thus carried to the liver where it gives rise to a hydatid cyst.

Man is infested in the same way as the ox or sheep from contamination by canine fæces Hydatid disease is therefore commonest in the country districts of stock raising countries such as Australia or the Argentine, and probably the transmission occurs mainly in childhood as a result of personal contact with the dog

A hydatid cyst lies within a false capsule or ectocyst of fibrotic liver tissue and has a lining membrane composed of two layers: the outer one is a tough chitinous layer through which no drug can penetrate the inner one or endocyst bears on its inner aspect the scolices or immature tapeworms Daughter cysts may form within the main cyst or bud out into the surrounding liver tissue.

Hydatid cysts grow slowly and at first cause few symptoms Indeed, the majority remain symptomless and ultimately become calcified. A large cyst gives rise to pain in the right subcostal region with a sense of fullness in the epigastrium and lower thorax. In some cases there are signs of anaphy axis—asthma nettle rash eosinophilia—owing to leakage of the foreign protein of the parasite through its chitinous envelope into the blood stream On examination a smooth rounded painless swelling sometimes the size of a fœtal head is palpable in the liver region

The diagnosis is to be made from simple cysts or simple tumours of the liver from enlargement of the right kidney and even from distension of the gall bladder by a stone in the cystic duct. The rare condition of cystic dilata tion of the common bile duct must also be borne in mind. Radiographic investigation (barium series pyelography cholecystography) assists in the diagnosis In addition a complement fixation test and Casoni's test a specific skin reaction produced by intradermal injection of hydatid fluid are of value

The complications are (1) rupture of the cyst into the bile ducts peritoneum bronchus, etc. (2) secondary infection of the cyst.

The treatment is by operation. The liver is exposed by a subcostal in cision or by resecting a rib A needle is then inserted into the cyst and 10 per cent. formalin injected to destroy the parasites The cyst is then opened, its contents evacuated, and its lining membrane avulsed. The cavity remaining is packed and its margins stitched to the edges of the abdominal wound.

PORTAL HYPERTENSION

This term is applied to conditions in which obstruction to the portal blood flow causes a rise in the blood pressure within the portal vein and its tributaries and this in turn leads to splenomegaly and to the development of œsophageal varices

The primary factor is usually chronic hepatitis, which may arise as a sequel to acute virus hepatitis or may occur insidiously with obscure causation. Much less commonly a congenital obliteration of the portal vein is at fault. Finally there are rare cases in which the portal vein or even the splenic vein alone become thrombosed as a result of injury.

The blood pressure within the portal vein normally equals about 100 mm. of water. In portal hypertension it may rise to 300. As a result, all the radicles of the portal vein become distended. The spleen becomes enlarged (this was formerly known as Banti's disease of the spleen) and may reach three or four times its normal weight. Microscopic examination shows the presence of siderotic (iron-containing) nodules due to small hæmorrhages.

In some cases the splenic enlargement leads to increased functional activity or hypersplenism which shows itself in microcytic anæmia and leucopenia.

The main risk to life in portal hypertension arises from the development of œsophageal varices. These are large thin walled veins which lie in the mucous and submucous coats of the lower half of the œsophagus. Often there is one large vein or sometimes more communicating distally with veins in the submucous plexus of the fundus and cardia of the stomach.

Bleeding results from rupture of a vein either in the œsophagus or the stomach. The hæmorrhage may be severe, catastrophic, and rapidly fatal. In such cases the vomited blood is bright red and its source is hardly in doubt. In less severe examples coffee ground material is vomited and the diagnosis must be made from bleeding peptic ulcer and bleeding carcinoma of the stomach.

The diagnosis of bleeding œsophageal varix may sometimes be made on the history of hepatitis, or on such signs as ascites or splenomegaly. The most positive evidence is provided by X-ray examination using a barium swallow which can nearly always be relied upon to show a filling defect due to the varicose vein.

The treatment of portal hypertension is not yet standardised and no method is uniformly satisfactory. It is generally agreed that surgical treatment is indicated only in cases with bleeding or with a history of recurrent bleeding. During an actual episode of hæmorrhage, a special inflatable bag may be used. The tube is introduced into the stomach the balloon is distended with air and traction is applied (using a 2 lb weight over the bedrail) so that the balloon abuts against the cardia, thus compressing the veins at that point. This treatment is of temporary value only but it serves to restore the blood volume by transfusion and it may lead to occlusion of the bleeding point by thrombus.

For more definite treatment various operations are on trial. Porto-caval anastomosis is sometimes practised, to reduce the pressure within the portal system. The older operation of splenectomy is still performed with some success. Finally it has been advised to transect the cardia and re-anastomose the œsophagus to the stomach, in order to obliterate all the submucous venous anastomoses.

CHOLECYSTITIS AND GALLSTONES

Some gallstones arise as aseptic formations due to metabolic disturbances which lead to crystallisation of cholesterol or the pigments bilirubin and biliverdin out of the bile. Others are believed to be formed by the precipitation of muddy deposits consequent on infection of the bile. Nearly all gallstones arise primarily in the gall bladder A few originate in the common duct.

In the great majority of cases cholecystitis or inflammation of the gall bladder wall occurs as a secondary result of the presence of stones.

In most cases cholecystitis is insidious in origin and chronic in course. Since its symptoms and those of gallstones are closely related the two conditions will be considered together Acute cholecystitis, which is nearly always a "flare-up of a chronic infection, will be described separately

Chronic Cholecystitis and Gallstones

Pathological Features. In chronic cholecystitis the gall bladder wall loses its normal blue-green translucency and becomes thickened, pale and opaque Organisms, especially coliform bacilli, can be obtained on culture in only about 60 per cent. of cases, more often from the gall bladder wall than from the bile.

Gallstones are of three main varieties —

(1) Pure cholesterol stones are aseptic formations of metabolic origin Generally there is a single stone—a cholesterol solitaire—ovoid, of large size and yellowish colour composed almost entirely of coarse radiate cholesterol crystals. It is formed by slow crystallisation of cholesterol from its supersaturated solution in the bile, probably as a result either of excessive cholesterol production or of a deficiency of the solvent bile salts

(2) Pure pigment stones are also aseptic formations of metabolic origin. They are due to precipitation of bilirubin (or rarely biliverdin) in combination with calcium, and are especially common in conditions, such as hæmolytic jaundice, characterised by excessive output of bile pigment. They are generally multiple, small, hard, black concretions, and may form either in the gall bladder or in the bile ducts.

(3) Stones of mixed composition (cholesterol, bilirubin calcium) are septic in origin, the result of mutual precipitation of bile and mucopus, a sequel to infection of the bile These are the common gallstones. They are generally multiple, perhaps numbering hundreds, and faceted less often there are a few large barrel shaped stones.

Clinical Features. Cholecystitis and gallstones are most common in stout middle-aged or elderly women. The symptoms are generally due to the mechanical effects of the gallstones. Typically there are attacks *of pain, often very severe*, located over the gall bladder in the right upper quadrant of the abdomen a little below the tip of the 10th rib. This pain is known as biliary colic. It arises with dramatic suddenness

a meal of eggs and fats is given, which should cause partial emptying of the gall bladder and a further radiograph is taken an hour or two later

The interpretation of cholecystograms is as follows A normal gall bladder shadow can be regarded as excluding biliary disease in a large proportion of cases, especially if it is reduced in size after a fat meal A gall bladder shadow containing negative areas gives definite evidence of non-opaque stones (Plate XIII, p 445) If the gall bladder is not visualised, the information is less reliable unless confirmed by a repeat examination, when it is strongly suggestive of biliary disease.

Recently biligrafin has been introduced as a more effective dye which is excreted in a concentration sufficiently great as to outline the common bile duct. It is given intravenously and must be injected slowly and cautiously to avoid toxic symptoms. X ray examination is carried out after periods of from twenty minutes to one hour

Complications. Gallstones may lead to the following complications —

(1) Acute cholecystitis and its various sequelæ.

(2) Stone in common bile duct.

(3) (rarely) Carcinoma of the gall bladder

Treatment. In nearly all cases of gallstones the treatment is by operation Cholecystectomy is the operation of choice The cystic duct is tied and divided close to its junction with the common duct, the cystic artery is tied at the same level and the gall bladder is gently stripped from its bed in the liver This operation is perfectly straightforward if performed carefully If not, there is a risk of damage to the common bile duct, with the formation of a biliary fistula and later a stricture, leading to obstructive jaundice and severe liver damage.

In old or feeble persons or if skilled attention is not available it may be preferable to perform the older operation of cholecystostomy in which the stones are extracted and the gall bladder drained

Acute Obstructive Cholecystitis

Pathological Features Acute cholecystitis is nearly always a flare-up of a chronic infection, precipitated by sudden blockage of the cystic duct by a stone. For this reason it is preferably called *acute obstructive cholecystitis*

Infection proceeds apace in the stagnant bile The gall bladder wall becomes engorged and acutely inflamed. In most cases the infection is not severe, and after a short acute course it gradually subsides As

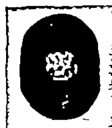


FIG 232. Combination stone from the gall-bladder shown in Fig 231 It consists of a pure cholesterol solitaire with a thick shell of secondary deposits.

the œdema lessens the stone is released and the cholecystitis relapses into a chronic state.

In more severe cases the gall bladder becomes distended with pus (empyema of the gall bladder) and may even become gangrenous. By this time nearly always the gall bladder is surrounded and walled off by adherent omentum, so the infection is localised but an abscess may form amid the adhesions. This abscess may absorb or it may burst into the duodenum or lead to a subphrenic abscess. Rarely in fulminating cases, the gall bladder perforates before protective adhesions have formed and floods the peritoneal cavity with highly infective bile, thus causing biliary peritonitis.

Clinical Features. The onset of acute cholecystitis is generally abrupt. There is severe pain under the right costal margin across the epigastrium and through to the back between the shoulder blades The pain is continuous and is accompanied by much bilious vomiting Shortly after the onset the temperature rises, perhaps to 101° or 102° F Often there is a slight rigor

On examination, a tinge of jaundice may be evident. There is hyperæsthesia in the right hypochondrium, most marked just below the tip of the ninth costal cartilage, and intense pain is elicited by even gentle pressure. The upper part of the right rectus muscle is rigid Deep palpation may reveal a large rounded tender swelling the distended gall bladder surrounded by omentum.

Diagnosis Acute cholecystitis is to be diagnosed from leaking duodenal ulcer a high appendix, pneumonia and acute pancreatitis. The first three rarely cause serious difficulty the fourth, pancreatitis, is recognised by the greater severity of its toxæmia and by the diastase test (p 453)

Treatment. It is customary to treat acute cholecystitis conservatively Antibiotics are given, local heat is applied preferably by a hot bag Heavy sedative is given to allay the pain Nearly always the acute phase subsides rapidly Owing to the risk of recurrence, cholecystectomy should be carried out a month or so later in all cases, unless especially contra indicated

Immediate operation is advised by a few surgeons for cases seen within the first twenty four hours, and at that stage in skilled hands cholecystectomy is not unduly difficult and gives admirable results In later cases operation should only be advised if the condition seems to be progressing towards perforation of the gall bladder or if the suspicion of pancreatitis is raised. In such cases simple cholecystostomy should be performed.

Stone in the Common Bile Duct

A stone expelled from the gall bladder on reaching the common bile duct generally causes partial obstruction to the flow of bile and fluctuant jaundice—a so-called ball valve obstruction. In some cases, however it lies latent, causing no symptoms, or on the other hand, in rare cases it may impact tightly and cause complete obstruction Sometimes the

stone gives rise to slight inflammation of the duct (cholangitis) Occasionally the cholangitis is severe and spreads upwards into the liver giving rise to multiple liver abscesses

Clinical Features. In typical cases there is a previous history of flatulent dyspepsia, perhaps with attacks of biliary colic. A particularly severe attack of pain heralds the passage of the stone into the common duct. Thereafter the pain recurs in less severe form as a constant deep gnawing sensation, in the midline and through to the back. Vomiting usually accompanies the pain



FIG 283. Operation cholangiogram, showing stone in common duct and multiple stones in gall-bladder

Usually there is jaundice of slight or moderate degree, which varies in depth from day to day and may disappear for days or weeks and then recur When jaundice is present the urine contains bile pigment and the stools are clay-coloured

The appetite is poor and there is some loss of weight. Often there is an intermittent pyrexia, perhaps to 99 F or so

On examination, there is tenderness on deep pressure under the right rib margin perhaps with slight rigidity The gall bladder is generally small because it is thickened by previous cholecystitis and because the obstruction to the flow of bile is not complete. It is therefore not palpable. This feature is of importance in the diagnosis from jaundice due to carcinoma of the pancreas.

Atypical Cases. Atypical cases are not infrequent. (1) The stone may lie latent for months, giving rise only to vague ill health and dyspepsia, with no pain and but faint occasional tinges of jaundice. (2) Rarely the stone impacts tightly and causes jaundice of progressively increasing depth. (3) The stone may lead to severe cholangitis and multiple liver abscesses. The symptoms of *Charcot's syndrome* then arise—jaundice of a greyish toxic hue, high intermittent pyrexia, rigors and much sweating, rapid wasting and tender enlargement of the liver.

Diagnosis. The diagnosis is to be made from other causes of jaundice, especially from acute hepatitis and from jaundice due to carcinomatous pressure. In typical cases there is no doubt, but difficulty arises in atypical cases especially if the previous history is lacking and if there is little or no pain. In such cases intravenous cholangiography is often helpful, but sometimes an exploration is advisable to clear up the diagnosis.

Treatment. The stone or stones (often there are several) must be removed by operation. The duct is exposed above the first part of the duodenum and opened by a vertical incision. The stones are removed very gently (to avoid crushing) by a fenestrated forceps or a scoop. Mud and debris is washed out. A probe is passed gently through the sphincter into the duodenum. Much care must be taken to leave no stone behind. If practicable, an immediate X ray is taken, after instilling diodone into the duct. Finally a fine straight rubber tube is introduced to drain the duct (or some prefer a T tube). As a rule, the gall bladder is removed too. If cholangitis is present, antibiotics should be administered.

CHOLESTEROSIS OF THE GALL-BLADDER

(Strawberry Gall-bladder)

In this condition the mucous membrane of the gall-bladder is infiltrated with large "foamy" cells containing cholesterol, which distend the villi and form small yellow polypi. Cholesterosis is essentially a metabolic change. The deposits in the mucosa are probably formed by cholesterol absorbed in excess from the bile. In the later stages chronic cholecystitis often supervenes and cholesterol gallstones often form.

Cholesterosis gives rise to no characteristic symptoms and its clinical features are those of mild cholecystitis *from which it cannot* be distinguished until the mucosa is inspected. The treatment, if the symptoms warrant operation, is to remove the gall-bladder.

CARCINOMA OF THE GALL-BLADDER

This disease, which is far from rare, occurs mainly in elderly women as a late result of the chronic irritation of gallstones. In most cases the symptoms are insidious, with pain of dull gnawing character below the right costal margin and occasional *vomiting*. Then jaundice develops owing to the pressure of secondary masses on the common duct. The jaundice is insidious but progressive and ultimately very deep. Abdominal examination reveals a stony-hard swelling in the right hypochondrium. Occasionally jaundice is the first symptom while in other cases a complication such as acute chole-

cystitis caused by the obstructive effect of the growth draws attention to it. In an early case the treatment is to perform cholecystectomy The majority however are inoperable.

JAUNDICE

Jaundice or icterus results from an excess of bilirubin or similar pigment in the blood and tissues Bilirubin is derived from the pigment of disintegrated red blood cells. The cells are destroyed in the reticulo-endothelial tissues, especially the spleen, and the pigment liberated The iron molecule is then abstracted and the iron free pigment is carried to the liver There it first reaches the Küpffer cells lining the sinusoids, and later is passed through the polygonal liver cells and excreted.

Three types of jaundice are recognised —

Hæmolytic jaundice, due to production of pigment in amounts too great for prompt excretion in the bile.

Hepatogenous jaundice in which the bile excretion is impaired by damage to the polygonal cells of the liver e.g in acute hepatitis or jaundice due to metallic poisons.

Jaundice from extra hepatic obstruction, due most commonly to stones in the common bile duct or to carcinoma in the head of the pancreas.

Diagnosis. Hæmolytic jaundice is readily distinguished from the other forms by the fact that the stools are normally pigmented Moreover the icterus is generally of mild degree, there is little or no bile in the urine, and the van den Bergh direct reaction is negative. In addition, there are other signs of the hæmolytic tendency such as fragility of the red cells (p 459)

Hepatogenous and obstructive types are more difficult to diagnose The following are the more common conditions to be distinguished —

(1) Acute hepatitis. In typical examples this disease starts abruptly with anorexia, nausea and perhaps vomiting; the jaundice lasts a week or two and then fades. In such cases the diagnosis is clear Occasionally however the disease is more severe and prolonged It is then apt to be mistaken for jaundice due to a carcinoma of the bile duct or pancreas, or to pressure by an extrinsic growth. In a doubtful case the blood bilirubin level should be estimated every few days in hepatitis it soon tends to diminish, while in carcinoma it persists.

(2) Stone in the common duct. The clinical features have been described on p 447 In typical cases the previous history the painful onset, the jaundice of variable degree or intermittent, and the slight pyrexia leave little doubt. In atypical cases with little pain and deep jaundice, carcinoma may be suspected

(3) Carcinoma of the common duct or pancreas, or extrinsic carcinoma pressing on the ducts The jaundice is insidious in onset, progressive and ultimately very deep Some pain may occur early but not the severe colic characteristic of a stone. If the growth is below the junction of the cystic and common ducts, the gall bladder is distended. In the case of secondary growths the liver may be palpably enlarged

and nodular and there may be clinical or radiographic evidence of the primary growth.

Courvoisier's Law states that in a jaundiced patient distension of the gall bladder betokens a malignant obstruction. This is because in such cases the obstruction is complete and the gall bladder having previously been healthy is capable of distension In jaundice due to a stone in the common duct the obstruction is rarely complete and the gall bladder is often thickened by old disease.

The liver function tests are sometimes of value in the differential diagnosis of jaundice. The thymol turbidity test and the cephalin cholesterol flocculation test tend to be strongly positive in toxi infective conditions such as acute hepatitis, but low in jaundice due to extra hepatic obstruction such as stones or carcinoma. Conversely the alkaline phosphatase level tends to be raised (over 30 units) in extra hepatic obstruction but not in toxic-infective conditions.

Complications of Jaundice. Apart from such complications as depression bradycardia and pruritus, there are two of especial surgical importance —

(1) Liver failure, especially apt to occur after operation as a result of the added trauma affecting liver cells already damaged

(2) Hæmorrhage, which also is especially apt to occur after operation. The hæmorrhage takes the form of a slow ooze into the depths of the wound or from mucous or serous surfaces. It is due to deficiency of prothrombin due to the faulty absorption of vitamin K in the absence of bile from the alimentary tract.

Treatment. In obstructive jaundice the treatment is to relieve the obstruction and, if possible, to remove the cause. Operation is indicated in all cases where the general condition permits, for even in carcinoma an anastomosis designed to short-circuit the bile is of value in mitigating the discomforts peculiar to jaundice.

Careful pre-operative and post-operative care is essential. For several days before operation fluids and glucose should be administered to guard against liver impairment. A vitamin K preparation should be given by intramuscular injection to raise the prothrombin level, and the injection repeated postoperatively if the prothrombin is deficient or if the bleeding time is increased.

In a deeply jaundiced patient the operation should be limited to simple relief of the obstruction, for additional shock increases the liver damage and wide exploration adds to the risk of bleeding After operation, fluids and glucose should be continued. Transfusion is of value.

CHAPTER 88

THE PANCREAS

ACUTE PANCREATITIS

This condition is better described as "Acute Necrosis of the Pancreas." It is characterised by destruction of the glandular tissue of the pancreas by the digestive action of its own juice (trypsin) Normally this secretion is quite inert until it reaches the duodenum, where it is activated by the enzyme enterokinase. In *acute pancreatitis* the secretion is activated within the pancreatic ducts, and thus acts directly upon the parenchyma of the gland.

The ætiology is in some doubt. The view held most widely is that the pancreatic secretion is activated by reflux of infected bile into the pancreatic duct this occurrence is rendered possible in a proportion of cases by the anatomical arrangement of the bile and pancreatic ducts, which generally open into a common atrium, the ampulla of Vater guarded at its orifice by the sphincter of Oddi. In some cases a stone impacted in the ampulla is responsible for the reflux in others spasm of the sphincter of Oddi is postulated.

Probably this theory of reflux is only applicable to a proportion of cases. In others, possibly some blood borne agent, or perhaps a primary vascular lesion, may be blamed.

Pathological Features. In the most severe cases when the abdomen is opened a turbid exudate is found in the peritoneal cavity Scattered over the omentum, on the peritoneal surfaces generally and sometimes in the retroperitoneal tissues, are numerous raised yellow white plaques of *fat necrosis* which result from saponification of the neutral fat by lipase set free from the pancreas. *Hæmorrhages* may be found, especially in the vicinity of the pancreas, due to erosion of blood vessels by trypsin The pancreas is swollen and brawny and in parts necrotic. The gall bladder is tense with muddy bile and often contains multiple small stones. A similar stone may be impacted in the sphincter of Oddi, but this is exceptional.

In milder cases, much commoner though less often diagnosed the condition is often mistaken for subacute cholecystitis and is thus more likely to be seen at operation (if at all) a few weeks after the attack. At this time peritoneal exudate is absent and there are few points of fat necrosis. The pancreas is swollen, hard and nodular and if a nodule is incised it is seen to be a focus of necrosis in process of being organised. Doubtless many such cases go untreated and eventually the pancreas returns almost to it original state

Clinical Features. In the most severe cases there are intense pain, violent retching repeated vomiting and early severe toxæmia.

The onset is abrupt, with diffuse pain in the upper abdomen and through to the back. Retching is a distinctive feature, and vomiting of bilious fluid occurs repeatedly The toxæmia leads to rapid collapse often with lividity or dusky cyanosis

On examination the shock is obvious. The pulse is rapid and weak, the temperature is but little raised, and may be subnormal The abdomen is distended, with diffuse rigidity and tenderness across the epigastrium.

In milder cases, the symptoms are similar to those of subacute cholecystitis, except that nausea, retching and hiccup are more pronounced Examination reveals diffuse tenderness and some rigidity across the epigastrium, but the constitutional impairment is not marked.

Diagnosis. In the most severe cases the diagnosis is to be made from perforated ulcer intestinal obstruction and coronary thrombosis. In the milder cases it is to be made from subacute cholecystitis.

The *diastase* or *amylase test* (estimation of diastase or amylase in the blood or urine) gives valuable evidence. The urinary diastase is measured by its ability to digest a standard starch solution. In pancreatitis it is greatly increased at the beginning of the attack but soon returns to normal. A high diastase index is also found occasionally in perforated ulcer and other acute abdominal diseases.

Treatment. It is now recognised that in most cases acute pancreatitis will subside under conservative treatment, and some surgeons believe that even in fulminating cases the risk of operation outweighs its advantages. In practice, however in fulminating cases there is often some doubt as to the diagnosis and urgent laparotomy may be advised to exclude perforated ulcer or high intestinal obstruction. In such circumstances the peritoneal exudate should be evacuated and the gall bladder drained to relieve tension within the biliary tract. Conservative measures include transfusion of blood or plasma to control the shock. Electrolyte deficiencies (sodium, potassium and calcium) must be made good. Later high protein feeding is needed to remedy the weight loss which is often severe.

In less fulminating cases and in those submitted to operation after the acute attack the common bile duct should be explored for stone.

RELAPSING PANCREATITIS

In this condition there are recurring attacks, similar to acute pancreatitis but of mild character with pain across the upper abdomen and through to the back accompanied by much retching, hiccup or vomiting The serum amylase may be high at the onset of the attack. In some cases relapsing pancreatitis is associated with a pancreatic calculus or a false cyst of the pancreas. The treatment is not yet fully standardised If gallstones are present they should be removed Sphincterotomy (division of the sphincter of Oddi) has been recommended

through to the back. Remarkably enough, the pain may be worsened by lying down. X ray examination after a barium meal may show displacement of the stomach or of the duodeno-jejunal flexure In late cases the hard mass may be palpable. A growth in this situation is rarely diagnosed in time for surgical removal, and no other treatment is effective.

(2) *Carcinoma of the head of the pancreas* forms a small hard growth which sooner or later—according to its site of origin—envelops and constricts the common bile duct. It may also compress the pancreatic duct. The clinical features vary In some cases jaundice is the first sign, in others there is a vague history of anorexia and loss of weight



FIG 234. Carcinoma of the head of pancreas in a man aged 45 years, who suffered from jaundice; painless in onset, gradually progressive and ultimately of deep greenish-black hue. The enlarged liver and distended gall-bladder are outlined.

which precedes the onset of jaundice. Pain occurs in about 50 per cent. of cases. Generally it is a mild ache, probably due to tension within the biliary tract and readily attributed to "indigestion." The jaundice is generally insidious in origin, and deepens progressively At first it is a yellow or orange tint, but later it becomes green as the bilirubin is converted to biliverdin, and ultimately the patient assumes a dark olive green hue. The jaundice leads to severe pruritus and this sometimes is the first sign directing the patient's attention to the disease.

On examination, the tumour is not palpable. Following Courvoisier's Law (p 451), the gall bladder is usually distended, but if it is deeply placed under cover of the enlarged liver it may not be felt.

(3) *Carcinoma of the ampulla of Vater* tends to be of a less malignant character more gradual in spread and slower to metastasise, and consequently it is the type most amenable to treatment. It gives rise to symptoms like those of carcinoma of the head of the pancreas, but with some notable variations. The common duct is obstructed early but since the growth tends to ulcerate it may relax its hold, so the

jaundice fluctuates or may fade completely for a few weeks only to recur and become progressively deeper Sometimes infection from the ulcerated growth spreads to the stagnant bile, giving rise to cholangitis with mild pyrexia, chills and rigors These features may lead to confusion of the diagnosis with gallstones in the common duct.

Special Investigations The fæcal occult blood test is generally positive in ampullary carcinoma, but a negative result carries no significance Liver function tests give the features of obstructive jaundice. X ray examination is rarely helpful until the late stages Tests of pancreatic function are valueless, possibly because the accessory duct of Santorini may remain patent. Often the only certain method of investigation is the exploratory laparotomy and it should not be delayed.

Treatment. In ampullary carcinoma the radical one-stage pancreatectomy is performed In this operation the head and neck of the pancreas is removed along with the pyloric part of the stomach and the whole duodenum (its blood supply being interrupted) A blind end of jejunum is brought up and into it are implanted severally the stump of the pancreas, the common bile duct and the cut end of the stomach.

In carcinoma of the head of the pancreas the same operation may be practised provided that the growth is not too extensive. However since the mortality is high and the end results poor it is generally better to perform a palliative short-circuit, which relieves the jaundice and the intolerable pruritus. For this purpose an anastomosis may be performed between the gall bladder and the stomach, duodenum or jejunum of these the cholecyst jejunostomy is generally preferred.

ISLET-CELL TUMOUR

This rare tumour is nearly always a simple adenoma—rarely carcinoma—arising from the islets of Langerhans. It is a small growth, rarely more than 1 cm. in diameter reddish yellow in colour and with no capsule. It elaborates insulin and gives rise to periodic attacks of hypoglycæmia with symptoms similar to those of insulin over-dosage—dizziness, faintness, somnolence and coma, or excitement and even mania. After repeated or prolonged attacks the nerve cells of the cerebral cortex suffer as a result of the lack of glucose and more permanent mental changes result. Thus there may be prolonged loss of memory and various psychic disturbances Sometimes they have led to the patient's incarceration in a mental institution.

The diagnosis can be confirmed by reproducing a typical hypoglycæmic attack. This is done by giving the patient exercise, for example on a stationary bicycle, while he is fasting The first sign usually is that the movements become wild purposeless or ataxic, and at this point a sample of blood is taken for sugar estimation. If the attack develops it can be cut short by giving glucose.

The treatment is to remove the tumour If minute, it may be

difficult to find It is recognised by touch more readily than by sight, being firmer on palpation than the normal pancreatic tissue If no growth is palpated, the body and tail of the pancreas should be removed in the hope that a microscopic tumour may be situated in that part. After operation there is a transient danger of hyperglycæmia until the normal islet cells which have been in abeyance resume their function. It is readily controlled by insulin.

A *non-insulin secreting adenoma* derived from the alpha cells of the islets occurs rarely in association with active peptic ulcers in stomach duodenum or jejunum. Its action is not understood.

CHAPTER 39

THE SPLEEN

THE spleen is an organ intimately connected with blood formation and destruction, and consequently many of its diseases are allied to blood dyscrasias.

One of the most important functions of the spleen, in common with other tissues of the reticulo-endothelial system, is to destroy effete red blood cells, setting free their pigment content for subsequent conversion into bilirubin In addition, the spleen takes part in the formation of lymphocytes (in the Malpighian bodies), and acts as a reservoir for red cells, pouring them into the circulation as required.

Despite its functional value, removal of the spleen has remarkably little effect upon the general health. There may be a temporary leucocytosis and temporary anæmia, but no permanent abnormality results.

Injuries to the Spleen. The spleen may be penetrated by a bullet or stab wound, or by a fractured rib forced inwards through the diaphragm, but much more often it is ruptured by indirect violence without injury to the overlying integuments.

Rupture of the spleen is generally caused by " crush " or " run-over " injuries in road or industrial accidents. If the spleen is enlarged, how ever, and soft and friable from disease, it may be ruptured by a comparatively trivial injury In rare cases rupture of the spleen has occurred spontaneouly owing it is thought, to sudden contraction of the plain muscle fibres of the splenic capsule.

In the common type of injury resulting from a severe crush there is a more or less complete tear of the splenic capsule and pulp, frequently involving the vessels at the hilum. At the time of the injury severe shock is usual, and the resulting fall of blood pressure tends to limit the immediate hæmorrhage, but when the phase of shock has passed and the blood pressure rises the bleeding is renewed. As in any form of hæmorrhage, the blood loss is at first compensated by constriction of all the peripheral blood vessels and increased heart rate for a few hours, therefore there may be no untoward signs. If the bleeding continues, however and the compensatory mechanism breaks down, the blood pressure falls and the patient soon dies unless treated.

In addition to the signs of blood loss—pallor, restlessness, increasing pulse rate and eventually collapse with air hunger—there are signs of free fluid in the peritoneal cavity and there may be tenderness and rigidity both over the spleen and generalised over the abdomen. Sometimes a deep-seated mass of clotted blood is palpable in the splenic region.

In occasional cases the hæmorrhage is delayed for a day or so or exceptionally for a week or more. Though delayed, it is none the less

severe and may prove fatal within a few hours. In such cases warning signs are usually to be found if sought. There may be tenderness and rigidity in the splenic region with sometimes referred pain through the phrenic nerve to the left shoulder there may be pyrexia and a tinge of jaundice due to absorption of blood clot, and in some cases a hæmatoma round the spleen is palpable.

The treatment is to remove the spleen with the least possible delay All free blood and clot should then be removed from the peritoneal cavity Blood transfusion may be required during and also after operation.

Mobile Spleen. Any spleen but especially one enlarged by disease may stretch its peritoneal attachments and become mobile. In exceptional cases it may hang from a long mesentery and may then undergo volvulus or even impact in the pelvis.

A mobile spleen causes few symptoms unless it undergoes volvulus when there is acute pain with vomiting In most cases the volvulus becomes reduced spontaneously, but recurs giving rise to repeated attacks of pain and vomiting The spleen is felt as a mobile rounded painless swelling which must be diagnosed from a mobile kidney or an ovarian cyst. The treatment is to remove the spleen.

Tumours and Cysts of the Spleen. Tumours primary or secondary, are of great rarity in the spleen. Primary angioma endothelioma and sarcoma are described. Carcinoma may involve the spleen by direct spread from the stomach.

Cysts are also rare. They include congenital polycystic disease, traumatic cysts due to liquefaction of a hæmatoma, and hydatid cysts. The treatment is to remove the spleen

Banti's Syndrome Portal Hypertension. It is now established that the syndrome described by Banti in 1894 is due to obstruction of the portal blood flow with portal hypertension. It is discussed on p 442.

Acholuric Jaundice. This is a form of hæmolytic jaundice, and is due to excessive destruction of red blood cells, with consequent liberation of pigment in too large amount for prompt excretion in the bile.

The red cells undergo lysis because they are unduly fragile, as may be demonstrated readily by adding a drop of the blood to hypotonic salt solutions of diminishing concentration normal blood does not completely lyse until the concentration of sodium chloride is reduced to about 0 35 per cent., whereas in acholuric jaundice the blood lyses at about 0·6 per cent.

The destruction of the fragile red cells takes place mainly in the spleen, which consequently is enlarged and shows great reticulo-endothelial proliferation, though no other pathological change.

Clinically there are two types of acholuric jaundice, the congenital and the acquired. In the congenital type jaundice and anæmia are often the only features. The jaundice is present from birth and, though variable, is never deep the anæmia is of secondary type, a result of the excessive destruction of red cells. Generally there are no other ill-effects and the patient is more jaundiced than ill." Since the pigment, unlike that in other forms of jaundice, has not been converted into bilirubin it is prevented by the size of its molecules from being

excreted through the kidneys, and the urine remains clear Bile production occurs normally, and consequently the stools are normally coloured. In some cases as a result of the excess of pigment secreted in the bile there develop gallstones of pigment type (p 444) which may give rise to symptoms through partial obstruction of the bile passages.

In the acquired type, which generally appears in adolescence, the jaundice is deeper and there may be attacks of fever and prostration, while the anæmia is also more severe.

In either type, but especially in the acquired there are acute phases, *hæmoclasic crises* characterised by *increased destruction of red cells* with severe anæmia and marked deepening of the jaundice. At these times the bone marrow responds by producing large numbers of immature red cells or reticulocytes, sometimes to the extent of 10 per cent. or even 20 per cent.

The diagnosis of acholuric jaundice is to be made from other splenomegalies and other forms of hæmolytic jaundice by demonstration of the red cell fragility

The treatment is to remove the spleen. In the great majority of cases, especially in the congenital type, this procedure is curative, although, remarkably enough, the red-cell fragility usually persists.

Purpura Hæmorrhagica (Essential Thrombopenia) This disease generally affects young females, and is characterised by a recurring tendency to hæmorrhages into the skin or from mucous or serous surfaces Hæmorrhage from the uterus is especially common, and may be so severe as to cause death from exsanguination.

The cause of the disease is not fully understood. The following features are found on examination during the bleeding phase —

(1) The blood platelets are reduced in number from the normal of about 200 000 per c.mm., perhaps down to zero

(2) Fragility of the capillary blood vessels is present, as recognised by the tourniquet test. In this test a sphygmomanometer band applied to the arm is inflated to just below the systolic blood pressure to distend the veins and capillaries. *Fragility of the capillary walls is indicated* by the development, within half an hour or less, of numerous petechial hæmorrhages into the skin of the congested limb

(3) The coagulation time is normal, but the blood clot does not retract and does not tend to staunch the flow Consequently the bleeding time (the time an ear prick continues to bleed if the blood is continually removed with blotting paper) is greatly lengthened.

The diagnosis is to be made from other forms of purpura, e.g in tuberculosis, septicæmia and other toxic states, by demonstrating the blood changes described above.

Cortisone is beneficial in some case of purpura and should always be *given a trial. If it is ineffective*, splenectomy should be advised as in a proportion of cases it brings about a cure of the disease.

CHAPTER 40

THE ADRENAL GLANDS

THE cortex and medulla of the adrenal glands are derived from different origins and they differ also in structure and in function. Correspondingly they are liable to different types of diseases.

Diseases of the Cortex

The adrenal cortex is the main site of production of the steroid hormones. It is the exclusive source of the hydroxycorticoids (which include hydrocortisone and cortisone) and of the electrolyte-controlling hormone aldosterone. In men, it shares with the testis in the production of the virilising members of the 17 ketosteroid group such as testosterone and androsterone, while in women it shares with the ovary in the production of oestrogens. In all these functions except aldosterone production it works under the influence of corticotrophin or ACTH derived from the pituitary gland.

The cortex is liable to two types of lesion (1) diffuse hyperplasia, which is usually provoked by excessive ACTH stimulation from a basophilic tumour or other disease of the pituitary; (2) tumours, including adenoma and carcinoma. In diffuse hyperplasia and some tumours the main clinical features are due to excessive secretion of steroid hormones, and depending on the type of hormone in greatest excess the result may be either Cushing's syndrome or the adreno-genital syndrome. The remainder of the tumours have no endocrine effects. Thus an adenoma unless very large may be symptomless, while a carcinoma may give rise to symptoms, like any other malignant growth, by invasion and metastasis formation.

Cushing's Syndrome. This condition may occur as a result either of adrenal cortical hyperplasia (secondary to pituitary basophilism) or of an adenoma or carcinoma of the adrenal cortex. Its manifestations are due mainly to the excessive production of hydroxycorticosteroids, though in some cases there is also an excess of the virilising ketosteroids.

The clinical features are most striking in female children or young women. The symptoms develop gradually but progressively during the course of a few months. There is an increase in weight, amounting perhaps to 40 or 50 lb., so that a girl previously slim becomes very obese.

Hirsuties is a prominent feature. Hair appears on the face, chest, abdomen and thighs, the pubic hair assumes the male distribution, while the hair of the scalp becomes short and coarse.

Amenorrhoea occurs early and is associated with atrophy of the ovaries and uterus. The clitoris may be greatly hypertrophied The

breasts are flat and atrophic. The voice assumes a deeper note. There may be perversion of sex desire.

The skin becomes coarse and dry, and acne is a common secondary effect. The blood pressure may be raised, and this may cause headaches and lead to polyuria. In some cases the sugar tolerance is lowered and glycosuria may result. (To cases of this type the term "diabetes of bearded women" may be applied.)

The diagnosis can be confirmed by demonstrating an increase in the urinary excretion of hydroxycorticoids. It is more difficult to determine whether the disease is due primarily to a pituitary lesion (with adrenal hyperplasia) or to an adrenal tumour In the former case X ray examination occasionally shows enlargement of the sella turcica. In the latter case, if the tumour is large it may cause deformity of the pyelogram (Fig 285) or may be visualised on X ray examination after injecting oxygen by the presacral route into the extra peritoneal tissues. Biochemical investigations may also be of value. If the manifestations are due to adrenal hyperplasia, a large dose (25 I.U) of ACTH will raise the urinary hydroxycorticoids still higher· if they are due to a tumour which is autonomous, it will not.

The treatment, if a tumour is present, is to remove the affected adrenal gland. If there is adrenal hyperplasia, the treatment is either to remove the whole of both adrenal glands, leaving the patient entirely dependent on cortisone maintenance, or to remove all but a small part of one adrenal, in the hope that it will suffice, or nearly suffice, for the normal cortisone needs.

Adreno-genital Syndrome. This condition also may be due either to hyperplasia or a tumour Its manifestations are due mainly to the excessive production of the virilising 17 ketosteroids. The most striking feature is a change in the secondary sexual characteristics towards a male type. In adults there is an increased masculinity with adiposity and hirsuties In boys there is precocious sexual development and excessive masculinity In young girls pseudo-hermaphroditism may occur

The diagnosis is confirmed by demonstrating an increase in the urinary excretion of 17 ketosteroids. The distinction between hyperplasia and tumour may be made as described above. If a tumour is present, it should be removed. If there is hyperplasia, good results may follow treatment by cortisone, which acts by inhibiting the pituitary stimulus to adrenal activity

Aldosteronoma. This rare tumour of the adrenal cortex secretes an excess of aldosterone, which by its action on the renal tubule leads to excessive loss of potassium and retention of sodium. It causes episodes of severe muscular weakness with tetany and paraesthesia. The low blood potassium provides the clue to the diagnosis.

Tumours of the Medulla

The medulla is derived from the anlage of the ganglia of the lumbar sympathetic chain, and its hormone—noradrenalin—is closely related to the action of the sympathetic system. In the course of its development

the adrenal medulla deviates from its primitive nervous character and its cells assume their distinctive appearance. Many of the cells contain chromaffin granules (granules stained by potassium bichromate) and consequently may be termed pheochromocytes (φαιω, I am attracted to)

Two types of tumour arise from the adrenal medulla the one reverts to the primitive nerve-cell progenitors of the gland, while the other retains more adult characters and retains the property of secreting adrenalin.

Neuroblastoma. This is a highly malignant tumour of primitive nerve-cell structure It affects infants and young children, grows rapidly and metastasises early

In some cases metastases infiltrate the liver which becomes greatly enlarged quite overshadowing the comparatively small adrenal growth (Pepper's tumour)



FIG. 235. Suprarenal tumour. The left upper calyx (right side of figure) is flattened and displaced down.

In other cases the growth shows a special tendency to metastasize in the region of the orbit (Hutchison's tumour) Here, again, the secondary tumour outgrows the primary and it may be mistaken for a primary growth, *such as a sarcoma of the orbit.*

Generally no treatment is available. In rare cases a tumour of less malignant character develops, containing nerve ganglion cells of adult pattern (*ganglioneuroma*) Such a tumour may prove operable.

Recently it has been claimed that tumours of neuroblastoma type will regress under treatment by large doses of vitamin B_{12}. The method is still under trial.

Pheochromocytoma. In most cases there are acute attacks with a sudden rise of blood pressure, pallor sweating, tachycardia and a sense of suffocation These paroxyms may last only a few minutes and may occur several times a day *or only* at rare intervals. In between the paroxysms the blood pressure usually is within the normal range, but tends to vary from one examination to the next.

In other cases the blood pressure is raised between the attacks, or there may be persistent hypertension without paroxysms

The tumour is usually of small size Sometimes it may be demonstrated by intravenous pyelography, which may show a displacement or deformity of the kidney or by X ray examination after oxygen insufflation via the presacral space.

Various tests are useful Phentolamine (Rogitine) an adrenalin antagonist, usually produces a sudden return of the raised pressure to normal. Probably the best test is for the urinary catecholamines. In some cases the only certain way of excluding phæochromocytoma is to expose both adrenals at operation

The treatment is to remove the tumour by operation. The operation is not free from danger owing to the risk of an acute fall of blood pressure when the tumour has been removed. To counteract this, noradrenalin is given intravenously

ADRENALECTOMY

Bilateral adrenalectomy is now in common use for cases of late breast cancer In about 80 per cent. of cases it brings about an arrest or regression of the malignant disease which is sometimes quite striking but unfortunately is never permanent. It is supposed that the benefit comes from abolishing the secretion of œstrogens. At the present time there is no method of determining which cases are likely to respond.

The operation is generally performed in two stages. At the first stage one adrenal is removed along with both ovaries (unless the patient is several years past the menopause, when the ovaries are atrophic) At this stage the operation carries no special dangers and no special after care is required. At the second stage, usually performed a week or two later the patient is suddenly deprived of all the adrenal hormones, so special after care is required. Cortisone must be given (starting the day before operation) commencing with 300 mg daily and gradually reducing to the usual maintenance dose of 50–75 mg daily Intravenous nor adrenalin may be required for several hours (though not invariably) The drip should be set up before operation with a bottle containing 4 mg noradrenalin in 10 oz saline, and the flow rate adjusted according to the blood pressure, which should be measured every fifteen minutes for the first twelve to twenty four hours. It is no longer thought necessary to give desoxycorticosterone, but a high intake of salt must be maintained permanently

Later the patient must be warned of the risks of even temporary failure to take cortisone. Cortisone withdrawal for more than thirty-six hours, or failure to absorb the cortisone owing to vomiting may bring on fatal collapse Unfortunately the early signs of cortisone deficiency are vague—apathy weakness, nausea, anorexia—and their nature is such that, however they are brought about, they tend to diminish the patient s awareness of, or interest in, the dangers of the situation. The

danger is aggravated by the fact that intercurrent stresses such as illness or injury increase the cortisone requirements, perhaps to double the normal maintenance dose and if this increase is not provided a serious deficiency will result. Every adrenalectomy patient should be given a printed card, to be carried in a pocket, reminding her of this vital information

CHAPTER 41

THE APPENDIX

ACUTE APPENDICITIS

ACUTE appendicitis is rare before the age of two In childhood it rapidly increases in frequency Between the ages of 10 and 30 it is extremely common, accounting for over 50 per cent. of abdominal emergencies. After the age of 30 it declines in frequency It may occur however even in old age.

The appendix owes its susceptibility to infection first to its structure as a blind diverticulum, easily occluded and in direct communication with the most septic part of the alimentary tract and secondly to the presence in its submucous coat of numerous lymphoid follicles, which are very liable to infection from the gut. The lymphoid tissue is scanty in infancy hence the rarity of appendicitis at this time. Like the pharyngeal lymphoid tissue, it commonly increases in amount in childhood, and after early adult life it tends to diminish.

Two fairly distinct types of acute appendicitis may be recognised, the catarrhal and obstructive types.

Catarrhal Appendicitis. This is a simple catarrh, due to infection from the gut. The appendix is turgid and inflamed, the mucous membrane is swollen, œdematous and congested, and the submucous lymph follicles are enlarged and may contain points of suppuration. In most cases catarrhal appendicitis pursues a mild course, and if left untreated it may subside in the course of a week or so This course cannot invariably be predicted however for in some cases the infection is more acute and leads to peritonitis or to local abscess formation.

Obstructive Appendicitis. Here the appendix is inflamed, and, in addition the lumen is occluded, generally by a fæcal concretion impacted at a point where the lumen is narrowed by a kink or adhesion or stricture. Behind the obstructing agent the lumen distends with fæcal pus of high infectivity and inflammatory changes proceed apace. The presence of infective pus under tension causes ulceration of the mucosa and then leads to gangrene of the entire thickness of the wall. These changes may take place with great rapidity and in fulminating cases it is common to find the appendix completely gangrenous within twelve or eighteen hours of the onset.

Further developments depend upon the environment of the appendix. If it lies buried in the extraperitoneal tissues behind the cæcum, or if the omentum has had time to envelop it, infection passing through the gangrenous wall leads to a local suppurative process—an appendix abscess. If, on the other hand, the appendix is free and intraperitoneal, it may perforate and discharge its highly infective content into

the free peritoneal cavity, giving rise to a virulent form of diffuse peritonitis.

Clinical Features

Often there is a history of previous attacks, similar but less severe, or there may have been previous indigestion due to chronic appendicular disease. Apart from such a history quite often in the few days preceding the acute attack there has been some irregularity of the bowels, either constipation or slight diarrhœa

Frequently the first symptom is pain, of gradual onset and never excruciating and this is followed by nausea and vomiting While such a sequence is very significant, it must not be expected in all cases, for occasionally nausea and vomiting come first, the pain later It should be emphasised also that while a slight rise of temperature is usual, it, too is not invariable; in obstructive appendicitis the temperature may be normal at first.

Examination at any stage after the first hour or so will reveal, amongst other signs, two characteristic ones —

(1) Tenderness on pressure over the appendix.

(2) Localised muscular rigidity over the appendix.

Later in the course of the attack there may be additional symptoms, due to diffuse or local peritonitis

Pain. In obstructive appendicitis there are two distinct sorts of pain, an initial midline pain and a slightly later pain localised over the appendix. In catarrhal appendicitis only the localised pain is felt.

The initial pain takes the form of a diffuse ache or of recurring colicky spasms referred to the midline of the epigastric or umbilical region. It is due to tension within the obstructed appendix or peristalsis of its muscle coat endeavouring to overcome the obstructing agent. The painful impulses, being transmitted along afferent sympathetic nerves to the tenth and eleventh thoracic segments of the cord, are interpreted as coming from the part of the abdominal wall supplied from those segments. Since the appendix, like the whole midgut, is originally a median viscus with bilateral innervation the pain is felt diffusely across the abdomen.

The localised pain comes on a few hours later The patient will state that the pain has shifted from the stomach to the right side. The localised pain is due to irritation of the mesenteric tissues or the sensitive parietal peritoneum related to the appendix. The pain is of a "sore, aching or stabbing character and is felt directly over the inflamed appendix. Its situation therefore varies according to the position of the appendix, which is highly inconstant. With the appendix curled up in the right iliac fossa the pain is felt at or near McBurney's point, a third of the way from the anterior superior spine to the umbilicus with a retrocæcal appendix it is felt further up and more laterally perhaps as high as the gall bladder or as far back as the kidney with an appendix overlying the pelvic brim it is felt immediately above the pubis; with the rare left-sided appendix it is felt on the left side.

Pulse and Temperature. It must be emphasised again that in the early stages *the pulse and temperature may be normal.* After a few hours the pulse rate begins to rise, perhaps to eighty or ninety while the temperature may reach 100 or 101° F A more rapid pulse or higher temperature at this early stage should call for reconsideration of the diagnosis.

Abdominal Examination. At an early stage, i.e. before the development of peritonitis or an abscess, two signs are nearly always to be

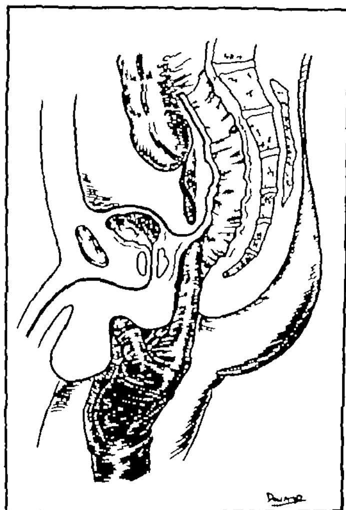


FIG. 236. Acute pelvic appendicitis. Method of eliciting tenderness by forward pressure of finger in rectum.

found, if sought carefully They are tenderness on pressure over the appendix and muscular rigidity over the appendix.

Tenderness on pressure is most marked if the inflamed appendix is in contact with the sensitive parietal peritoneum. If it is close to the surface there may also be hyperaesthesia. If, on the other hand, the appendix is deep-seated, behind the caecum or buried between coils of small intestine, the tenderness is elicited only on deep pressure.

The site of tenderness varies according to the position of the appendix. With the appendix curled up in the right iliac fossa the

tenderness is at or close to McBurney's point. With the appendix in the retrocæcal position it is at some higher point or in the flank above the iliac crest. With an appendix overhanging the pelvic brim it is only to be felt on deep pressure immediately above the pubis or on forward pressure by a finger in the rectum.

The pelvic appendix is the type most likely to be missed, for the symptoms are not always typical, the pain is deep-seated and rather ill-defined, and the tenderness on ordinary abdominal examination is not marked in the early stages. Tenderness on forward pressure by a finger in the rectum is always present, however and in a doubtful case this examination should never be omitted

Muscular guarding is due to reflex spasm of the muscles over the inflamed peritoneum related to the appendix. It is a very valuable sign, always present except in the rare cases where the appendix is deeply buried or low in the pelvis.

It should be emphasised that the rigidity in the early stages of appendicitis is not to be compared to the board like rigidity over a *perforated* ulcer It is easily missed if the examination is carried out roughly and is best perceived by very delicate palpation with the flat of the abdomen inch by inch.

The extent of the rigidity varies according to the position of the appendix. Generally at an early stage there is an area of rigidity 2 or 3 inches in diameter centred over McBurney's point. With a retrocæcal appendix the oblique muscles immediately above the iliac crest are mainly affected, while the front of the abdomen may be quite soft. With a pelvic appendix the rigidity is late in appearance and limited to a small area immediately above the pubis.

Perforated Appendix

The appendix may perforate as early as twelve hours after the onset of pain After forty-eight hours it is unlikely to perforate, for by then the omentum has generally enveloped the appendix and any escape of infection is walled off

The occurrence of perforation adds greatly to the gravity of the condition, for highly infective pus and perhaps fæcal concretions are discharged into the peritoneal cavity and cause a virulent type of diffuse peritonitis.

At the time of perforation the pain, previously reduced to a dull ache, becomes suddenly intensified, like a stab with a knife. Thereafter the pain remains severe and assumes a "sore, burning character spreading across the abdomen as the extent of the peritonitis increases.

From this point the general condition takes a rapid turn for the worse. The pulse becomes increasingly rapid and weak, the temperature rises, perhaps to 102 or 103° F and vomiting recurs. Later the respiratory rate increases, the peripheral circulation is impaired, and finally the patient becomes dehydrated, hollow-eyed and very toxic.

Abdominal examination shows all the signs of peritonitis, at first limited to the lower part, later spreading diffusely The lower abdomen

symptoms rather like a high retrocæcal appendix, with tenderness and rigidity on the right side. In most cases both tenderness and rigidity are most marked over the first part of the duodenum, but as the irritant fluid gravitates the tenderness may spread downwards as far as the level of the umbilicus or lower. The maximum rigidity, however, is in the hypochondrium, and this with the history points to the correct diagnosis.

Acute cholecystitis may simulate appendicitis if the gall bladder is unusually low. In most cases the character of the pain, the repeated bilious vomiting and the situation of maximum tenderness, hyperæsthesia and rigidity serve to distinguish it.

Acute kidney diseases (*pyelitis, pyonephrosis, stone*) give rise to pain, tenderness and sometimes rigidity, but generally they are at a higher level and further back than in appendicitis. In pyelitis the temperature is higher (102° to 103° F.) and often there is a rigor. The urine contains some pus cells and numerous organisms, usually coliform bacilli. In pyonephrosis also the urine is infected, and, in addition, the kidney is enlarged and tender. In stone the pain is of sudden onset and the urine contains red blood cells.

Acute thoracic diseases (*pleurisy, pneumonia*) may give rise to referred abdominal pain but not to true rigidity. The onset is usually more abrupt, the pain is worse on inspiration and there may be a "catch" in the breath, the temperature is often higher, the face is flushed, the pulse-respiration ration is diminished, the alæ nasi may move on respiration, and careful examination will reveal changes at the right base. X ray examination gives confirmation.

Pelvic Appendix. *Diseases of the female pelvic organs* are a common source of difficulty in diagnosis. *Acute salpingitis* gives rise to pain, tenderness and rigidity immediately above the pubis. Generally the pain is bilateral from the start, and there may be a purulent vaginal discharge. Frequency of micturition may be present early. Rectal or vaginal examination reveals bilateral pain at an early stage, whereas this sign only appears in appendicitis at a later stage, with the onset of pelvic peritonitis. *Twisted ovarian cyst or fibroid* gives rise to pain in the lower abdomen, with tenderness and rigidity. Rectal or vaginal examination reveals the tense rounded swelling. *Ruptured ectopic gestation* occurs where a fertilised ovum has failed to reach the uterus and been arrested in the Fallopian tube. Rupture usually takes place during the second month of pregnancy, leading either to the formation of a large blood clot in the pelvis or, more often, to free bleeding into the peritoneal cavity. Usually there is a history of a missed period and perhaps of the "morning sickness" of pregnancy. At the time of rupture there is a severe cutting pain in the lower abdomen, succeeded by faintness due to internal blood loss. Shoulder tip pain, due to the irritation of blood under the diaphragm, is a characteristic feature. Vaginal examination reveals a mass on one side of the pelvis.

Stone in the right ureter, especially if impacted at its lower end, gives rise to pain in the lower abdomen and to localised tenderness and

rigidity over the site of impaction. The urine contains red blood cells and radiography will generally reveal the shadow of the stone.

LATE STAGE. At a late stage of a perforated appendix with diffuse peritonitis the diagnosis is to be made from other forms of peritonitis. The history of the onset of the disease is then of special importance in the diagnosis.

Treatment of Appendicitis

Unless there is a clear contra indication the treatment is by operation. The incision should be placed for ease of access if the appendix is thought to be in the iliac fossa, a grid iron incision is most often used. It gives very restricted access, so if the appendix proves to be deeply placed or adherent or on the point of rupture there should be no hesitation in enlarging the wound It can be enlarged upwards by cutting through the muscles in the line of the oblique skin wound; downwards by entering the rectus sheath and displacing the rectus muscle medially

If the appendix is thought to be retrocaecal, an oblique incision should be chosen, extending upwards an inch or so medial to the anterior superior spine and dividing all layers in the same line· if pelvic, a right paramesal incision gives best access The appendix is removed, and if it is perforated or enclosed in an abscess, a drain should be inserted.

Treatment of Appendix Abscess. When the case is seen late, with clear signs of local abscess formation, the delayed method of treatment (see below) may often be carried out with advantage. If the abscess is large, especially if it is situated in the pelvis, or if for any other reason the delayed method is inadvisable, the treatment is to drain the abscess, leaving the appendix *in situ*. To remove the appendix, which in such cases is generally buried in soft vascular friable adhesions in the abscess wall, involves the risk of spreading the infection and is generally unwise. Appendicectomy should be carried out three to six months later to guard against recurrence.

Treatment of Perforated Appendix. When the appendix has perforated, operation is urgently necessary for every hour's delay then means more extensive peritonitis. After the appendix has been removed the peritoneal exudate is carefully mopped out and it is usually wise to insert a drain Post operative treatment for peritonitis (p 379) is then instituted antibiotics are given fomentations are applied to the abdomen, fluid is given in large amount, preferably by continuous intravenous drip and peristalsis is minimised by withholding food and prohibiting aperients. The patient is nursed in the semi sitting (Fowler) position, so that the peritoneal fluid gravitates towards the pelvis and thus gains free exit at the drainage opening

Treatment of Appendicitis in Pregnancy The older view still held by many was to ignore the pregnancy and treat by operation in all cases. This treatment leads to a miscarriage in a considerable proportion of cases, especially in the first three months of pregnancy

It seems wiser to adopt a more conservative attitude. In the first place, the diagnosis must be established beyond reasonable doubt

(pyelitis of pregnancy and toxæmic vomiting must be excluded) If the disease progresses rapidly, with severe pain over the appendix, if vomiting is repeated, if there is marked local rigidity, and if the area of tenderness increases, the appendicitis is not likely to resolve and should be treated by operation Progesterone should be given intramuscularly to reduce the risk of miscarriage

Delayed Treatment. This treatment is most suited for late cases in which the infection appears to be resolving or progressing to a circumscribed abscess. It is designed to supplement these natural attempts at healing so that operation may be delayed until the dangers peculiar to the critical stage are past.

It must be emphasised that it should only be adopted by those well versed in abdominal diagnosis, and only in a hospital where continuous skilled observation can be undertaken.

Indications (1) In cases seen forty-eight hours or more after the onset, in which there is no sign of diffuse peritonitis and the disease appears to be stationary or subsiding

(2) In late cases with a palpable swelling—an abscess or an inflammatory mass of omentum round the appendix—and no evidence of diffuse peritonitis.

(3) Where the attack is of mild character and operation is rendered unsafe by such conditions as pregnancy or active tuberculosis.

Details of Delayed Treatment. The first aim of the treatment is to keep the inflamed parts absolutely at rest the second is to counteract the toxæmia.

The patient is placed comfortably in bed with the head raised on pillows The old "Fowler position" is unnecessary A wide-spectrum antibiotic is administered. Fluids are given by the mouth or intravenously No aperient must be given until the infection has settled—usually five or six days or longer—but the bowel may be opened by enemas.

For the first day or two the pulse rate should be recorded two-hourly and if a significant rise is noted operation should be reconsidered. If an abscess forms it should be opened and drained removal of the appendix is postponed until two to three months later

Post-operative Complications

The following complications are prone to follow operations for acute appendicitis, especially in late cases in which the appendix has perforated —

(1) Residual Pelvic Abscess The abscess generally develops a week or so after the operation and gradually increases in size. The first signs are that the patient ceases to improve, feels tired, and loses his appetite. The temperature is raised a degree or two Abdominal examination reveals tenderness, rigidity and slight fullness in the lower abdomen. On rectal examination a tender swelling may be palpable in the pelvis. The treatment in the early stages is to apply fomentations for a few days, for many small abscesses resolve. If the suppuration

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continues the pus must be evacuated, either through the original wound or by a new incision.

(2) Subphrenic Abscess (p 882)

(3) Paralytic Ileus (p 411)

(4) Intestinal Obstruction due to an Adhesion (p 407)

(5) Pylephlebitis (p 441)

(6) Fæcal Fistula. This complication is generally due to necrosis of part of the cæcal wall near the base of the appendix. Often the immediate post-operative period has been a difficult one, and the development of the fistula is followed by a sudden improvement in the general condition. The treatment is conservative, and generally the fistula closes spontaneously If not, operative closure should be delayed for several months, except in cases of small intestine fistula, for which the treatment is as described on p 424

RECURRENT AND CHRONIC APPENDICITIS

The symptoms and signs of chronic appendicular disease vary widely and for convenience they may be described under four headings —

Recurring attacks of subacute appendicitis The attacks are similar to those described above for catarrhal appendicitis, but of mild character In the intervals there may be no symptoms, or those described below In this type the diagnosis is not in doubt.

Recurring appendicular colic An appendix containing concretions or other foreign bodies may give rise to recurring spasms of colicky pain, due to excessive peristalsis in its efforts to expel the object. Appendicular colic is common in children as a result of thread worms in the appendix. In adults it may be caused by concretions, fruit stones, or even lead pellets swallowed in shot game. The diagnosis is to be made from colicky spasms caused by constipation or partial obstruction due, for example, to adhesions or tuberculous strictures. Generally there is deep pain on pressure over the appendix Radiographic examination may be of value (Plate XIII, facing p 445)

Chronic grumbling appendix This term aptly describes the type of appendix that gives rise to frequent aching or dragging pains in the right lower quadrant. The appendix is thickened and fleshy with much inflamed lymphoid tissue in its submucous coat (the abdominal tonsil "), or rarely there is a mucocele of the appendix, due to distension with mucus behind a stricture at its base. The pain is never severe, but is a dull ache, worse on much standing or at the end of the day's work. The general health may be impaired. The diagnosis is to be made in young persons from tuberculous ileo-cæcal glands; in females from disease of the right ovary or tube in adults from stone in the ureter or carcinoma of the cæcum, or simple constipation associated with cæcal dilatation

Radiographic Examination. Radiographic examination is of value

in chronic appendicitis, first to exclude other lesions, secondly because it may give positive evidence of appendiceal disease. After a barium meal the appendix may sometimes be outlined, and seen to be long tortuous, kinked or adherent. Concretions may occasionally be shown up and stasis within the appendix may be demonstrated in films taken at successive periods. Tenderness elicited by pressure over the visualised appendix is a valuable diagnostic sign Negative evidence is of no value, for the normal appendix cannot always be visualised

CHAPTER 42

THE KIDNEY AND URETER

Investigation of Urinary Diseases

Clinical Examination. In all diseases of the urinary tract it is essential to examine not merely the kidneys and bladder but also the other systems The cardiovascular system in particular should be examined with care, for it is often affected in renal disease. The blood pressure should be estimated as a routine.

Enlargement of the kidneys should be recognised on abdominal examination To palpate a kidney press one hand deeply into the loin below the last rib to displace the kidney forwards and palpate with the other hand placed in front, meanwhile instructing the patient to take deep breaths. Normally the left kidney is not palpable, and only in a thin person can the lower pole of the right kidney be felt, unless it is unduly mobile. An enlarged kidney presents a smoothly rounded lower pole, which can be gripped by the palpating hand during deep inspiration and is felt to slip back towards the diaphragm on expiration It is dull on percussion posteriorly but tympanitic in front, owing to the presence of the colon.

A dilated bladder should also be recognised on abdominal examination. It presents as a rounded swelling, dull on percussion which rises behind the pubes towards the umbilicus.

Rectal examination should be carried out as a routine. The prostate is readily palpated, and the seminal vesicles can be felt if thickened by disease. The testis and epididymis should also be palpated to exclude such lesions as tuberculosis, orchitis or a tumour

Lastly inspection of the penis may reveal some unsuspected cause for obscure symptoms, e.g a tight phimosis, the scar of a healed syphilitic sore, or fibrosis round an old stricture.

Examination of the Urine. As a routine the urine is examined for albumin, sugar blood and pus. In many cases also a centrifuge deposit should be examined microscopically for red cells, pus cells and organisms. A catheter sample of urine may be required in confirmation and for bacterial culture. If evidence of infection is found, it is generally advisable to repeat the examination on urine obtained from the two kidneys separately by ureteral catheterisation.

Cystoscopy This examination supplies invaluable evidence in many diseases of the urinary tract. The cystoscope is a tubular instrument, electrically illuminated, carrying a telescope through which the bladder can be inspected Most cystoscopes can accomodate ureteral catheters and are fitted with a lever to tilt the end of the catheter into the corresponding ureteral orifice. Special cystoscopes may also be

used for fulgurating a bladder tumour and for other intravesical procedures.

The bladder is first washed out and filled with saline or boric lotion Its capacity should be noted, for any significant reduction below 300 ml is an indication of bladder disease especially tuberculosis Next the bladder walls are inspected for evidence of cystitis, a stone, ulceration a tumour or a diverticulum The vesical aspect of the prostate is inspected. Finally the ureteral orifices are located and inspected and their periodic contractions observed

Ureteral catheters may then be inserted to collect the secretions independently from the two sides and for retrograde pyelography after the injection of an opaque fluid such as 12 per cent. sodium iodide.

Radiographic Examination. A simple radiograph should show a faint outline of the lower poles of the kidneys, and thus indicate their size It should also show all urinary calculi except minute concretions A radiograph with the ureteral catheters *in situ* serves to show the position of the ureter and the relation to it of any shadow of doubtful origin. Finally the pyelogram will show any deformity of the renal pelvis, calyces or ureter

Intravenous Pyelography This method is simpler to carry out than retrograde pyelography and has replaced it for routine use. It is especially valuable as an index of the function of a kidney when the other one is to be removed Uroselectan or a similar substance (radio-opaque owing to its iodine content) is injected intravenously, the usual amount being 20 ml. It is excreted promptly by a healthy kidney, but slowly and imperfectly by a kidney with impaired function Radiographs are taken at intervals after five, fifteen and thirty minutes, and, if the suspected kidney is not completely functionless, its pelvis, calyces and ureter will thus be visualised In addition the time of appearance of the pyelogram serves as a rough index of the renal efficiency

Renal Function Tests. Only when the large reserve of renal tissue proves inadequate do renal function tests show any significant deviation from the normal. Consequently they only indicate the grosser degrees of renal impairment. Often indeed, the first indications are found on clinical examination—thirst, a dry tongue, anorexia, headache drowsiness, nausea, vomiting

The following tests are in common use.—

Urine Tests In the urea concentration test 15 grams urea are given by mouth in 100 ml water The urine secreted during the first, second or third hour thereafter should contain 2 to 4 per cent. of urea. In the urea clearance test the urea concentration of the urine during a test period is compared with that of the blood

The volume of urine excreted (day and night) should be measured in all cases, and its specific gravity noted. The specific gravity of the night specimen should normally be 1020 or over- if the kidney is unable to concentrate, it may fall to 1010

Blood Tests In advanced kidney disease the urea, non protein nitrogen and creatinine are retained in the blood. Renal disease is indicated by an increase in the urea or of the N.P.N to over 40 mg per cent., or in the creatinine to over 3 mg per cent. It should be noted that the figure for urea nitrogen is sometimes given instead of the total urea. The normal range for urea nitrogen is 12 to 18 mg per cent., and any increase above 30 mg per cent. may be regarded as significant.

ANURIA OLIGURIA

Depression of the renal secretion is to be distinguished from retention of urine in the bladder The distinction is readily made by passing a catheter

Calculus Anuria is generally due to blockage of one ureter by a stone, the other kidney being absent, or functionless as a result of previous disease. The anuria develops suddenly following an attack of renal colic. X ray examination confirms the diagnosis. Urgent treatment is demanded, and generally it is necessary to remove the stone by operation.

Sulphonamide Anuria is generally thought to be due to blockage of the ureters by sulphonamide crystals. To prevent it, in patients on sulphonamide treatment, the fluid intake should be adequate (5 pints daily) and the urine should be rendered alkaline. If anuria develops the ureters should be catheterised and washed out with saline solution. Since tubular damage may be a factor the treatment described below should also be given.

Tubular Necrosis. This is the commonest and most important cause of anuria or severe oliguria. In some cases the tubular damage is due to prolonged renal ischaemia, as in severe untreated shock or hæmorrhage. In others, for example the "concealed internal hæmorrhage" of obstetrics and in puerperal sepsis, there is a toxic factor Anuria after a mis matched transfusion is attributed to blockage of the tubules by acid hæmatin though doubtless aided by the shock or hæmorrhage for which the transfusion had been carried out. Lastly anuria after severe crushing injuries of muscles may be due, in part, to blockage by myo-hæmoglobin

The treatment of this type of anuria has changed radically in recent years. The main principles are (1) to limit water intake to the amount needed to compensate for invisible loss and such losses as vomiting or fistulous discharges (2) to allow no electrolyte intake unless blood studies show a deficiency (3) to allow no protein intake, in order to minimise the retention of urea and other nitrogenous products (4) to give a sufficiency of protein-sparing carbohydrate.

As a routine the patient is given each day 1 litre of 40 per cent. glucose, by mouth, or if there is vomiting, by the veins. Since hypertonic glucose quickly causes clotting in small veins, a polythene catheter should be inserted *via* the saphenous vein into the inferior vena cava above the hepatic venous level. With care it may be left in place as

long as two weeks. No other fluid or food is given except for weight by weight replacement of vomit or other losses.

Under such treatment patients may be kept alive, with almost complete anuria, for three weeks or more, but in most cases before then the tubular cells regenerate and secretion is resumed. Then diuresis sets in, with severe loss of water sodium and potassium, and careful and accurate replacement must be made. In addition, daily estimation of serum electrolytes and CO_2 combining power should be carried out.

Where this method of treatment fails, or is impracticable, the patient may be sent to a centre where an artificial kidney is available. This is an apparatus in which blood, withdrawn from a catheter in the vena cava, is pumped through a coil of flat cellophane tubing immersed in a bath of electrolyte solution The cellophane forms a semi permeable membrance, so that toxic products leak out, while the electrolyte level of the blood can be adjusted by appropriate changes in the bath fluid

HÆMATURIA

In severe hæmaturia the urine is thick with red blood, perhaps clotted in slight degrees it is merely tinged to a port wine or a smoky hue. The milder forms are to be distinguished from hæmoglobinuria and from discoloration by drugs, such as senna, rhubarb, sulphonal. The distinction is made by demonstrating red cells in the urine

Causes. Bleeding may arise as a result of trauma, inflammation, tumour or stone in any part of the tract. The more important causes are as follows (excluding trauma) —

Kidneys Acute nephritis, tuberculosis, tumour stone, polycystic disease, essential hæmaturia.

Ureters Stone.

Bladder Cystitis tumour, stone.

Prostate Congestion, simple enlargement.

Localisation of the Hæmorrhage. Often it is only possible to locate the source of bleeding with certainty by a full urinary investigation A guess may sometimes be hazarded on such clinical evidence as the following —

Kidneys The blood is intimately mixed with the urine and is usually present in several consecutive specimens, gradually tailing off to a smoky hue in a day or two In some cases there are " pencil clots formed in the ureter Passage of such clots may give rise to renal colic. The kidney may be palpably enlarged. In nephritis, casts may be found in the urine.

Ureters Generally there is renal colic as the stone traverses the ureter

Bladder The blood is often copious, and sometimes it is in completely mixed with the urine. One specimen may be heavily loaded, the next one, passed an hour or two later almost free. Sometimes large clots are present. There may be a history pointing to bladder disease.

Prostate The blood is most copious towards the end of micturition. There may be a history of "prostatism."

In many cases the history and clinical examination give a clear lead to the diagnosis. Thus, a history of severe colics suggests a stone, and X ray examination gives immediate confirmation a history of frequency of micturition suggests cystitis, or possibly tuberculosis, and microscopic examination of the urine gives supporting evidence in an elderly man with a large prostate, the probable diagnosis is evident, in a healthy patient with no symptoms other than hæmaturia, the possibility of a tumour either of kidney or bladder must be entertained.

Investigation of Hæmaturia. Often hæmaturia is the only complaint, and there is no indication of its source. In all cases it is of vital importance to locate the source of bleeding beyond all possible doubt, and to diagnose its cause. This can only be done by a complete urinary investigation. Wherever possible, the investigation should be carried out without delay for when the bleeding has ceased its source is difficult to locate.

The first step is to perform cystoscopy If the source of bleeding is in the bladder or prostate it can then be seen at once and the cause diagnosed while if it is higher in the urinary tract the blood can be seen issuing in jets from the corresponding ureter Ureteral catheters are then passed radiographs are taken, and finally retrograde pyelography is carried out

Essential Hæmaturia. This is a form of renal hæmorrhage of obscure origin The bleeding may be severe and recurrent and may come from each kidney in turn

Essential hæmaturia should be diagnosed only when an organic cause for the hæmorrhage can be excluded. With modern methods of investigation it is easy to eliminate gross diseases of the kidney but such small lesions as a minute angioma or papilloma, or a patch of chronic nephritis can rarely be excluded with certainty

The treatment is by palliative measures. If the bleeding is copious, transfusion may be necessary Operation should be avoided, unless as a life-saving measure, for there is often a tendency for a similar lesion to develop later in the other kidney

CONGENITAL ABNORMALITIES

Absence or Atrophy of One Kidney This is a rare abnormality but one of vital importance when removal of the existing kidney is under consideration. The ureter also may be absent, and in such cases the abnormality can be recognised on cystoscopy If the ureter is present, atrophy of the kidney may be suspected by the small size of the pelvis seen in a retrograde pyelogram but the diagnosis is made with most certainty by the absence of a shadow on intravenous pyelography

Horse-shoe Kidney In the embryo the kidneys lie side by side close to the midline, and may readily become fused. Generally fused kidneys lie somewhat obliquely at a lower level than normally and their lower poles are connected by a transverse bar of renal substance which crosses the midline in front of the promontory of the sacrum.

The abnormality is by no means uncommon owing to the liability of a horse-shoe kidney to hydronephrosis and to stone formation it is often seen

surgically In addition, the transverse bar is very liable to be ruptured by a blow on the abdomen.

The diagnosis may be made by abdominal palpation, or more certainly by pyelography A pyelogram shows the kidneys displaced downwards, obliquely placed and with each renal pelvis (which always emerges from the front) superimposed upon the shadow of the calyces

Pelvic Kidney In the embryo the kidneys lie in front of the second piece of the sacrum and only later ascend to the loin As a rare abnormality one kidney or the two fused together remain in the pelvis forming an irregular mass in the retroperitoneal tissues. Such a kidney is very liable to hydronephrosis, stone formation, and infection from the rectum It may also cause symptoms by pressing on the rectum or the bladder It may be mistaken for a tumour of the broad ligament or the retroperitoneal tissue Before excising such a mass it is important to determine that the other kidney is present and functioning

Double Ureter One or both ureters may be duplicated in part or in whole (Fig 243). There are no symptoms and no treatment is required.

Faulty Insertion of Ureter Rarely one ureter is inserted into the vulva vagina, urethra or rectum giving rise to partial incontinence of urine. The treatment is to transplant the ureter into the bladder

RUPTURE OF THE KIDNEY

The kidney may be ruptured by a direct blow, e.g a kick in the loin or in forcible flexion of the body, e.g in a fall from a height. The injury varies from a small laceration of the renal parenchyma to a complete tear across the kidney

The injury gives rise to severe pain in the loin and severe shock. On examination there is tenderness over the kidney with marked rigidity of the overlying muscles A hæmatoma soon collects in the perirenal tissues and gives rise to a swelling which fills out the loin. Hæmaturia occurs in all but the mildest cases. The bleeding generally subsides spontaneously in the course of a few days In severe cases, however it is copious, and may even lead to fatal exsanguination. Clots may form in the renal pelvis and cause renal colic during their descent to the bladder, or clots may form in the bladder and cause retention of urine. Rarely the blood escapes into the peritoneal cavity

The complications, in addition to shock and hæmorrhage, include renal suppuration, anuria (if the other kidney is absent or diseased) and necrosis of the kidney

The treatment in most cases is on conservative lines. The patient is kept quiet and at rest, with opiates if necessary The side is firmly strapped and bandaged. If clots in the bladder cause retention, a large catheter must be passed and the clots evacuated by lavage.

Operation is indicated for severe hæmorrhage threatening life or if suppuration occurs In the former case the tear is closed by deep sutures, or if this is impossible, it may be necessary to remove the kidney For suppuration the treatment is to drain the abscess.

NEPHROPTOSIS MOBILE KIDNEY

The perinephric fascia, which encloses the kidney and its surrounding fat, forms a closed box above and at the sides, but is deficient below The

kidney though anchored by its vessels, may thus acquire a considerable range of movement downwards behind the posterior parietal peritoneum. The adrenal gland, being enclosed in a separate compartment of the perinephric fascia, does not accompany it.

Mobile kidney occurs mainly in women as part of a general visceroptosis. The right kidney is affected in nearly all cases Formerly it was blamed for many of the obscure abdominal symptoms which trouble visceroptotic women but the present tendency is to regard it as completely symptomless and harmless. If discovered in the course of routine examination it should be ignored. A neurotic woman should never be told she has a mobile kidney for she may attribute all *future symptoms real or imaginary to it.*

Formerly it was thought that undue mobility of the kidney might give rise to acute pain and vomiting through kinking and obstruction of the ureter or vascular pedicle—*Dietl's crisis*—but if this does occur it must be excessively rare.

HYDRONEPHROSIS

In this condition the renal pelvis and calyces are dilated, and the renal parenchyma is correspondingly atrophied by pressure. In some cases the ureter shares in the dilatation.

Causes. (1) Congenital Abnormality In congenital hydronephrosis the kidney may be small and completely atrophic, perched upon a large sac formed by the distended renal pelvis or the hydronephrosis may be of moderate degree and only become manifest later in life. In some such cases seen in later life the renal pelvis is ballooned out, and there appears to be an obstruction at the junction of the renal pelvis with the ureter This may be due to fibrosis or possibly to a valvular formation at this point. In some cases an abnormal renal artery crosses immediately below the pelvi-ureteral junction, and it or the fibrous strands accompanying it may in part be responsible for the hydronephrosis.

(2) Organic Obstruction. Hydronephrosis is caused by any form of obstruction to the flow of urine, especially if the obstruction is partial or gradual in onset and long-continued. The obstructing agent may be at any point in the urinary tract. If it is in the kidney or ureter the *hydronephrosis* is unilateral if in the bladder or urethra it is bilateral. The common causes are as follows —

Kidney A stone or a tumour

Ureter A stone, a stricture, a primary tumour (rare) or compression from without, e.g by a pelvic tumour

Bladder A stone or a tumour or long-continued distension, e.g in lesions of the spinal cord.

Urethra. Prostatic disease or a stricture or even phimosis.

(3) Achalasia of the Ureter A slight degree of hydronephrosis and dilatation of the ureter are common in pregnancy as a result, it is thought, of neuro-muscular imbalance at the lower end of the ureter resulting perhaps *from endocrine effects.* This pregnancy dilatation often predisposes to pyelitis (p 488)

Clinical Features. A hydronephrosis may remain symptom-free for many years. When the symptoms do eventually develop they are

PLATE XIV



FIG. 237 Congenital stricture of the ureter with hydronephrosis and ureteral dilatation, in a boy of six years.



FIG. 238 Bilateral hydronephrosis. On the left the hydronephrosis is of extrarenal type and possibly congenital in origin On the right it is of intrarenal type, and in this case was due to a calculus wedged in the pelvi-ureteral junction.

usually of chronic character with a dull aching pain in the loin or a feeling of weight in the affected side of the abdomen

In some cases the condition of "intermittent hydronephrosis" develops, i.e. an open hydronephrosis which becomes intermittently closed There is then severe pain in the loin radiating down towards the groin accompanied by nausea, vomiting and a certain amount of shock. When the obstruction is released a sudden polyuria may be noted.

Occasionally a sudden hæmorrhage occurs into the dilated sac, leading to hæmaturia.

On examination a hydronephrosis of moderate size renders the kidney palpably enlarged. If the hydronephrosis is very great the renal pelvis is palpable as a smooth rounded, cyst like swelling which fills out the loin and can be displaced forwards towards the front.

Diagnosis. The diagnosis is confirmed by radiography A simple radiograph may show the outline of the enlarged kidney, while pyelograms, whether intravenous or retrograde will show the dilatation of the renal pelvis and calyces. At an early stage the first sign is that the calyces lose their cup-like appearance and become clubbed Later they become progressively dilated and the renal pelvis becomes enlarged In some cases the renal pelvis lies deeply placed within the hilum of the kidney and, being supported by the kidney substance, it does not dilate much. The dilatation in such cases affects the calyces mainly and consequently the renal parenchyma suffers from pressure atrophy In other cases the pelvis is mainly extrarenal and it then undergoes marked dilatation while the calyces remain comparatively unaffected

Treatment. (1) Remove the cause of the obstruction if possible.

(2) In slight hydronephrosis, especially if bilateral, drainage and lavage of the renal pelves should be carried out. To do this introduce a ureteral catheter drain off the urine from the hydronephrotic sac, and wash it out. This treatment may be repeated at intervals of a few weeks.

(3) In unilateral hydronephrosis of considerable extent, operation is indicated. Occasionally a plastic procedure designed to enlarge the pelvi ureteral junction is successful more often nephrectomy is necessary

INFECTIONS OF THE KIDNEY

Acute Pyelitis

This is an acute infective process mainly confined to the mucous membrane of the renal pelvis. It is commonest in young women and generally affects the right kidney It is especially common during pregnancy owing to the predisposing effect of the ureteral dilatation and urinary stasis seen in that condition In nearly all cases the infecting organism is *Bacillus coli*, presumably derived from the intestinal tract.

The onset is sudden, often with a rigor The temperature rises rapidly to 102 or 103° F., often there is vomiting and the patient looks flushed and toxic. Pain is felt in the right loin, radiating round

the side towards the groin. Micturition is frequent, and is accompanied by scalding pain referred to the urethra. Examination reveals tenderness on pressure over the renal pelvis and rigidity of the overlying muscles. The urine is slightly turbid and highly acid it contains a few pus cells and numerous coliform bacilli.

Diagnosis. Pyelitis must be distinguished from pneumonia, cholecystitis and appendicitis In typical cases the diagnosis is easy in atypical cases it may be difficult. It must be remembered that coliform organisms are often present in the urine, especially in women, and that their presence alone does not signify pyelitis. The urgent need is to exclude appendicitis, and this can usually be done on the history of onset, the general appearance of the patient and the local signs.

Treatment. (1) Give bland fluids in large quantities—water barley water lemon drinks.

(2) Give an alkaline diuretic mixture, containing large doses of sodium bicarbonate, potassium citrate and acetate.

(3) Administer sulphanilamide.

(4) In severe cases, especially in pregnancy, if these measures do not suffice and the condition appears to be progressing to pyelonephritis, pass a ureteral catheter and leave it in place for twenty four to forty eight hours to ensure complete drainage of the renal pelvis.

Pyelonephritis, Pyonephrosis

These terms are used rather loosely to denote acute infective *processes of more serious character affecting* both the *renal pelvis* and the parenchyma of one or both kidneys.

A unilateral lesion of this type is generally found as a complication of renal calculi, or rarely as a complication of simple hydronephrosis A bilateral lesion is generally a sequel to an obstructive lesion of the lower urinary tract such as an enlarged prostate or stricture of the urethra. The infecting organisms, often mixed include *B coli, streptococci*, staphylococci and *B proteus*

Clinically pyrexia, rigors and toxæmia occur with tender enlargement of one or both kidneys. The urine is infected, except in rare cases of unilateral ' closed pyonephrosis, where the ureter on the affected side is blocked.

The treatment depends on the cause. In unilateral calculous disease the affected kidney may be removed. In other cases antibiotics are given, and any obstruction to the urinary outflow relieved.

Perinephric Abscess

Causes. Perinephric abscess is generally caused by *staphylococcus aureus* and results from blood borne infection derived from *the throat* or a skin furuncle.

Less often it is secondary to calculous pyonephrosis when the infecting organism is generally *B coli*, sometimes in combination with streptococci and *B proteus*



Fig. 239 Pyelitis of pregnancy From a pyelogram (retouched). The right kidney (left side of picture) is hydronephrotic and the ureter dilated and tortuous. Left kidney normal.



Fig. 240. Tuberculosis of the kidneys. On the left side there is an early lesion, a small abscess cavity communicating with the lowest calyx the remaining calyces are normally cupped. On the right side all the calyces are enlarged and of blurred outline owing to their lining membrane of granulation tissue. The ureter is dilated and tortuous through implication in the disease.

Rarely tuberculous perinephric abscess occurs as a sequel to tuberculosis of the kidney or spine.

Clinical Features. If the infection is acute the temperature is raised and there are the customary symptoms of suppuration Examination reveals a diffuse swelling which fills out the loin. There is marked tenderness on pressure. The signs of fluctuation are obscured by the overlying muscles. In tuberculous abscess the swelling is of similar character but painless.

The treatment for acute perinephric abscess is to open and drain it through a small oblique incision over the site of maximum swelling in the loin. A tuberculous abscess may be aspirated, and its cause must receive the appropriate treatment.

TUBERCULOSIS OF THE URINARY TRACT

Tuberculosis of the urinary tract is nearly always due to blood borne infection by bacilli derived from a primary focus in the lungs. Generally the *disease starts in one kidney If untreated it tends to spread down* the ureter and infect the bladder and finally to ascend the opposite ureter or the second kidney may be infected like the first, by further blood spread

The disease in the kidney originates in a number of tuberculous follicles in the renal parenchyma. The follicles enlarge, undergo caseation become confluent and burst into a calyx. Infection of the renal pelvis and ureter follow The disease then reaches the bladder spreads over its base, and ultimately involves the second ureter

While the disease is usually progressive, as described above, there are rare cases in which, after destroying one kidney it becomes stationary and later regresses. In such cases the kidney is completely replaced by caseous matter and may ultimately become calcified. The ureter is closed off no urine is secreted from that side, and the whole disease practically dies out.

Clinical Features. Renal tuberculosis generally occurs in young adults. The onset is insidious, with gradual impairment of health, some loss of weight and perhaps a slight occasional pyrexia.

Frequency of micturition is the first and most characteristic symptom. The frequency is due at first to irritation of the bladder by early disease spreading from the ureteral orifice to the bladder base. In the later stages it is due to induration and contraction of the bladder and is severe, both during the day and at night. The frequency may be associated, with pain during and after micturition and with strangury

Hæmaturia is of frequent occurrence, and may be the first indication of the disease. *Pain in the loin is sometimes present*, but is not a notable feature.

On examination the kidney is usually a little enlarged, but painless. Often it cannot be palpated, and in such cases examination of the abdomen may be entirely negative

Investigation A full urological investigation is carried out. The urine is examined for pus cells and micro-organisms. A catheter specimen is submitted for bacteriological culture and for inoculation into a guinea pig

X ray examination and pyelography will show changes, varying from a slight woolly irregularity of one calyx to dilatation and roughening of the pelvis and whole calyx system The ureter may be dilated and tortuous.

Cystostomy at an early stage reveals changes round the orifice of the affected ureter with œdema and congestion Later there are superficial ulcers and tubercles may be visible in the mucous membrane These changes spread and finally involve the whole bladder wall.

Treatment. The patient should be admitted to hospital and given the general treatment for tuberculosis, including especially the antibiotics and anti tuberculous drugs, streptomycin, para amino-salicylic acid and iso-nicotinic acid. This generally brings about arrest of the disease. Nephrectomy is indicated if one kidney is completely caseous or is functionless due to longstanding ureteral obstruction.

TUMOURS OF THE KIDNEY

Adenocarcinoma, Hypernephroma

This is the commonest tumour of the kidney It originates in the renal parenchyma, grows steadily and ultimately reaches large size, forming a globular mass of bright yellow colour often partly cystic and usually discoloured extensively by hæmorrhages into its substance.

Microscopically the tumour is composed mainly of solid masses of large cells with a peculiarly clear cytoplasm containing cholesterol and other lipoid substances. These cells closely resemble those of the adrenal cortex, and for this reason von Grawitz suggested that it originated in "rests" of adrenal tissue such as are occasionally found in the kidney substance (hence the name "hypernephroma) It is now recognised however that in most cases the tumour also contains cells arranged round tubules or acini, and the present-day view is that the tumour is an adenocarcinoma derived from cells of the renal tubules.

The tumour invades surrounding tissues and has a special tendency to grow along the renal vein, when detached cells may give rise to metastases in the lungs, bones or other tissues. On the left side in men it may obstruct the internal spermatic vein and cause a varicocele. In nearly all cases the tumour grows into a calyx or the renal pelvis, and thus leads to hæmaturia.

Clinical Features. The tumour occurs in middle-aged persons Hæmaturia is generally the first sign. The bleeding is generally symptomless and may be profuse. Often it continues for several days and then gradually diminishes, the urine becoming port wine coloured and then smoky before it completely clears

Pain occurs if blood clots are forced down the ureter but apart from

this the disease is painless until the late stages, when there may be a dull ache in the loin.

In some cases the first evidence of the disease is given by hæmoptysis or a pathological fracture, due to a metastasis in the lungs or a bone.

On examination, the tumour if large, may be palpable as a rounded or globular mass. In the early stages, however, clinical investigation is quite negative.



FIG. 241 Hypernephroma of kidney

Diagnosis. The presence of blood in the urine at any age must be regarded seriously and its cause discovered by a thorough investigation. If possible, cystoscopy should be performed during the hæmorrhage. The blood will then be seen issuing from the one ureter, and the side of the lesion will be proved. In confirmation, urine obtained by ureteral catheter is examined for blood cells, and a culture may be taken to exclude infection. A pyelogram clinches the diagnosis by revealing deformity or a filling defect of one or more of the calyces or the renal pelvis.

Treatment. The treatment is to perform nephrectomy. Especial care is necessary in exposing the renal vein, which may contain tumour growth.

Papilloma of the Renal Pelvis

This rare tumour is a villous papilloma similar to the common papilloma of the bladder. It is very apt to cause profuse symptomless hæmaturia. Rarely daughter papillomata become engrafted in the ureter or even in the



FIG. 242. Tumour of the kidney. A bulky tumour originating at the upper pole of the kidney has obliterated the uppermost calyx and is projecting down into the renal pelvis.



FIG. 243. Tumour of renal pelvis. On the right side the lower part of the renal pelvis and lower calyces are obscured by a large irregular filling defect due to the growth. A double ureter is seen on the left side.



FIG 244 Bilateral polycystic kidneys. The kidneys are enlarged and the pyelograms correspondingly elongated. On the right side the uppermost calyx is deformed by the pressure of the cysts

FIG 245. Bilateral renal calculi



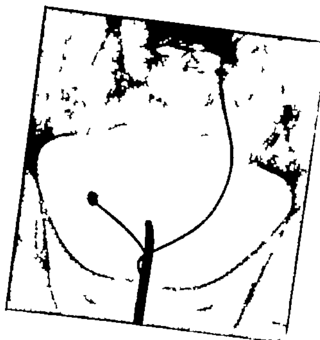


FIG. 246. Stone in the ureter The ureteral catheter is held up at the level of the stone The shadow in this case is unusually dense.

bladder The diagnosis is made by cystoscopy, which (if performed during the bleeding) determines the side affected and by pyelography which reveals a filling defect within the renal pelvis The treatment is to perform nephrectomy

Carcinoma of the Renal Pelvis

This tumour may develop from a simple papilloma or arise as a primary malignant growth Rarely it is caused by the chronic irritation of a stone The tumour has the character of a papillary adenocarcinoma or rarely of an epidermoid carcinoma The latter type a squamous epithelioma is believed to arise from metaplasia of the transitional cell membrane

The tumour gives rise to hæmaturia usually symptomless but sometimes with dull aching pain in the loin It is liable to secondary infection which may proceed to pyonephrosis

The diagnosis is made by cystoscopy which (if performed during the bleeding) determines the side affected and by pyelography which reveals a filling defect within the renal pelvis The treatment is to perform nephrectomy

Embryoma Wilms Tumour

This is a rare mixed tumour believed to be derived from embryonic rests, probably of Wolffian origin It occurs in infants and children up to the age of seven years The tumour grows rapidly and eventually attains huge proportions. It compresses the renal pelvis but does not ulcerate into it, and gives rise neither to hæmaturia nor to other urinary symptoms The child loses weight and suffers from vomiting and partial intestinal obstruction owing to the pressure of the tumour The huge mass filling the abdomen is to be diagnosed from tuberculous ascites and from a tumour of the adrenal medulla (p 402) or of the sympathetic nerve ganglia (p 70) In the early stages before multiple metastases develop the treatment is to perform nephrectomy

CYSTS OF THE KIDNEY

Polycystic Disease. In this developmental abnormality both kidneys are occupied by innumerable cysts, which replace the renal parenchyma, reduce the amount of functioning tissue, and lead eventually to renal failure.

The kidney is developed from two sources—the secretory tissue comes from the metanephros, which is closely related to the Wolffian body while the collecting tubules, renal pelvis and ureter come from a diverticulum of the Wolffian duct. Early in embryonic life the two unite and the secretory tubules are thus enabled to discharge their secretion. Polycystic disease is believed to be due to failure in this process, whereby some of the secretory tubules having no outlet become cystic.

The clinical features generally become manifest in early middle life, when progressive impairment of renal function sets in. There are symptoms of incipient uræmia—loss of energy anorexia, headache, loss of weight and later vomiting, drowsiness, coma. Often the symptoms come on after an intercurrent illness. In some cases hæmaturia is the first sign, or dragging pain in one or both loins may draw attention to the renal enlargement.

On examination, one or both kidneys may be felt to be greatly enlarged, and in some cases the cysts are palpable as smoothly rounded bosses on the kidney surface.

The diagnosis is confirmed by pyelography which shows both kidneys affected to a greater or less degree. In some cases the renal pelvis and calyces are deformed by the pressure of the cysts, which do not, of course, communicate with the urinary passages; in others the pelvis is of normal shape, but on a large scale and greatly elongated

The treatment is by medical measures, to conserve the available renal tissue.

Solitary Cyst. The kidney may be the site of a solitary retention cyst, or rarely of a hydatid cyst. There is a smooth rounded swelling, sometimes the size of the fœtal head. It is generally painless and may acquire a considerable range of movement. The diagnosis is difficult. In some cases a pyelogram demonstrates slight deformity of one or more of the calcyes

The treatment, if the symptoms demand operation, is to perform nephrectomy providing the other kidney is healthy

STONES IN THE KIDNEY

Types of Stone. *Oxalate stones* (calcium oxalate) are generally single, small, very hard, and with a rough surface blackened by discoloured blood. They arise as aseptic formations in acid urine. Being hard and rough, they cause severe pain and bleeding and traumatise the kidney readily

Uric acid or urate stones may be single or multiple. They are generally smooth, of yellowish-brown colour, rounded or faceted by mutual pressure. They also are aseptic formations and arise in acid urine.

Phosphatic stones are generally multiple and large, greyish white, soft and chalky They are often bilateral, and may form an irregular cast of the renal pelvis and calyces on one or both sides. Phosphate stones arise as a result of inflammatory change in alkaline urine they are especially common as a result of infection by urea-splitting organisms such as staphylococci and *B proteus*

Cystein stones are rare, and arise as a result of a familial disturbance in the metabolism of cystein an amino-acid product of protein metabolism. Normally cystein is destroyed in the liver but in certain families it is excreted unchanged, and may give rise to stone formation. Cystein stones are pale, soft and almost waxy The cystein can be recognised by its colourless hexagonal crystals

Causes of Urinary Stones. Two main predisposing causes of stone are recognised.

(1) Any disease leading to skeletal decalcification and consequent increase in the urinary excretion of calcium. In this category come osteitis fibrosa (due to parathyroid disease) the decalcification which follows prolonged decubitus in major fractures or in tuberculous disease of a bone or joint, and various other types of severe skeletal decalcification.

(2) Infection of the urine by urea splitting organisms such as staphylococci and *B proteus* which make the urine alkaline and precipitate phosphates.

In the majority of cases, however, neither of these factors is present, and the cause of the stone formation remains obscure

Pathological Effects. A stone generally forms in one of the calyces or the renal pelvis, and may remain latent for a long time.

By pressure-irritation it may cause gradual replacement of the kidney by fibrous tissue. More often it obstructs the flow of urine and causes hydronephrosis

A stone predisposes to infection and leads to pyonephrosis Rarely it predisposes to carcinoma.

Clinical Features Pain is the first and principal symptom. There is a dull pain in the loins, especially after jolting movements If the stone impacts in the ureter it causes renal colic. This is an intense, sickening griping pain which starts suddenly in the loin and radiates round the side to the groin, scrotum or vulva, and the inner side of the thigh. It is often accompanied by nausea and vomiting and may cause a certain amount of shock. During the pain the muscles overlying the kidney are held rigidly contracted.

Hæmaturia is common, especially after an attack of pain.

Examination may reveal tenderness on deep pressure over the kidney but in most cases the clinical examination is quite negative.

Diagnosis. All urinary stones except minute particles may be seen in radiographs taken with modern apparatus. A stone in the kidney gives a dense, clearly defined homogeneous shadow A small one is usually rounded or ovoid; a large one tends to assume the shape of the cavity in which it lies, and may form a "stag horn" cast of the renal pelvis and calyces.

A renal stone must be diagnosed from other shadows seen in radiographs, particularly a calcified gland, a highly calcified gallstone, an enterolith, or a mass of barium or other opaque matter in the colon.

The diagnosis is confirmed by means of a pyelogram, which, in addition, will show the exact situation of the stone and the extent to which the kidney is damaged.

Treatment. *Unilateral Stones* (1) If the kidney is not severely damaged, remove the stone by pyelotomy (through an incision into the renal pelvis) or nephrotomy (through an incision into the kidney substance) If the pelvis is dilated it should be drained by a self retaining catheter

(2) If the kidney is severely damaged and the other kidney is healthy nephrectomy should be performed.

Bilateral Stones If the general health permits, remove the stones by pyelotomy or nephrotomy Generally deal first with the kidney that will most quickly recover its function

STONES IN THE URETER

A stone reaching the ureter from the kidney may pass at once into the bladder or may become impacted in the ureter Generally the stone causes a partial obstruction to the urinary flow and leads to progressive

dilatation of the ureter and to hydronephrosis. Infection of the stagnant urine may supervene. At the site of impaction the stone may ulcerate the mucous membrane and lead to a stricture.

Clinical Features. Nearly always the stone in descending the ureter gives rise to renal colic, rarely the descent is painless. An impacted stone may cause pain at the site of impaction, and on the right side this may be mistaken for appendicitis, especially as the overlying muscles may be rigid.

Hæmaturia is nearly always found, either as obvious discoloration of the urine or by the microscopic demonstration of red blood cells

Diagnosis. Renal colic—intense sickening pain originating in the loin and referred to the groin or external genitalia—may result from many causes, including stones in the kidney, hydronephrosis, and the passage of blood clot down the ureter Oxaluria is sometimes responsible for intense pain of this type, and finally there are many cases of transitory or recurrent colic in which despite full investigation the cause cannot be determined.

In the diagnosis of ureteral stone reliance is placed mainly upon the radiograph, in which it is revealed as a well-defined shadow, often ovoid or elongated, in the line of the ureter It is to be diagnosed from other shadows in or near to that line. In the upper part of the ureter it must be distinguished from a calcified gland, an enterolith, or a separately ossified tip of one of the transverse processes, lower, from calcified concretions or foreign bodies in the appendix in the pelvis, from phleboliths, which commonly cause multiple, clearly-defined rounded shadows.

The diagnosis is completed by intravenous pyelography This verifies that the suspected shadow is in the line of the ureter which may be slightly dilated above the obstruction. If the stone is impacted at the lower end of the ureter cystoscopy may reveal œdema of the orifice or stone may even be seen projecting into the bladder

Treatment. Conservative measures are indicated if the stone is small and if intravenous pyelography shows both kidneys to be excreting well. Fluids are given in large amounts, and anti spasmodics are prescribed. Small stones generally pass spontaneously within a few weeks

Operation is indicated if the stone is large, if renal function is impaired, or if conservative methods fail despite adequate trial. The ureter is exposed by a suitable incision and the stone removed. Occasionally, if the stone is impacted near the bladder the mouth of the ureter may be dilated or incised through an operating cystoscope to aid expulsion.

If there is anuria, the treatment is as described on p 478

CHAPTER 43

THE BLADDER AND URETHRA

DISTURBANCES OF BLADDER FUNCTION

The mechanism of filling and emptying the bladder is under the control of the automatic nervous system, through the agency of two sets of fibres, which are sometimes known as the filling and emptying nerves. The "filling" nerves, which cause relaxation of the bladder and contraction of its sphincters, are derived from the ganglionated sympathetic chain and reach the bladder by way of the hypogastric plexus (the so-called presacral nerve) a leash of fibres running down from the bifurcation of the aorta. The "emptying" nerves, which cause contraction of the bladder and relaxation of its sphincters, are parasympathetic fibres derived from the sacral outflow of the spinal cord.

Voluntary control of the bladder is probably exerted through fibres in the internal pudendal nerve, controlling the external sphincter

The stimulus to urinate occurs when the increasing intravesical pressure forces a few drops of urine into the sensitive prostatic urethra. The stimulus from the prostatic urethra sets up a reflex action through the micturition centre of the lumbar region of the spinal cord, and, subject to the control of the higher centres, this leads to parasympathetic stimulation and thus to urination.

The Bladder in Diseases of the Nervous System. The function of the bladder may be affected in a variety of diseases of the brain and spinal cord, especially in (1) tabes dorsalis and disseminated sclerosis (2) injuries to the spinal cord, (3) spina bifida.

(1) Tabes dorsalis and disseminated sclerosis give rise to symptoms rather like those of prostatic disease, and if other signs of nervous disease are absent the diagnosis is somewhat difficult. There are frequency of micturition with difficulty in starting the act, intermittency of flow and dribbling after micturition. Later the bladder fails to empty completely the residual urine gradually increases, the bladder becomes progressively distended, and ultimately the condition is one of complete overflow incontinence. The "back pressure" thus caused may give rise to bilateral hydronephrosis and impairment of renal function.

(2) Injuries to the spinal cord (p 251) paralyse the "emptying" nerves and lead to passive dilatation of the bladder with overflow incontinence. If the lumbar micturition centre is destroyed this condition is permanent; if the injury is at a higher level, after six weeks or so the lumbar centre may regain its activity and lead to reflex micturition.

(3) Spina bifida in some cases impairs the emptying mechanism and leads to gradual distension of the bladder and overflow incontinence.

The condition develops slowly in childhood or adolescence and gives rise to a severe degree of bilateral hydronephrosis, and thus to impairment of renal function. In some cases the condition may be relieved by dividing the presacral nerve, and thus restoring the balance between "filling" and "emptying" nerves.

Incontinence of Urine. Incontinence of urine may arise from a number of causes —

(1) Incontinence in cerebral degenerative lesions is seen commonly in elderly persons suffering from cerebral thrombosis or other degenerative lesions.

(2) Incontinence due to injury to the bladder sphincters is seen occasionally after prostatectomy A similar condition occurs in women with severe prolapse of the uterus and cystocele.

(3) Incontinence with uncontrolled reflex micturition is seen in the late stages after an injury to the spinal cord above the lumbar centre, and occasionally in diseases such as disseminated sclerosis. In this condition the bladder empties spontaneously on reaching a state of partial distension.

(4) Incontinence due to overflow from a distended bladder may follow retention of urine from any cause.

Nocturnal Incontinence, Enuresis. A child normally gains control *of the bladder at from two to three years of age. Nocturnal incontinence* in children beyond that age may arise from many causes.

The commonest cause, apart from mental impairment, is faulty training other causes are high acidity of the urine, the presence of uric acid crystals in the urine, phimosis, threadworms. Rarely a *congenital abnormality such as epispadias or faulty implantation* of one ureter into the urethra or vagina is responsible. This last named lesion is suggested if the child is able to pass water under normal control at normal intervals, but in addition dribbles constantly both by night and day

It is most important, in the first place, to deal with any organic disease which may be present, *so a thorough investigation is essential.* In addition to the clinical examination and urinalysis, intravenous pyeography should be done. The presence of a double ureter will suggest the possibility of faulty implantation. Finally the urethra and vagina should be examined minutely under anæsthesia.

If this investigation is negative, it must be assumed that the cause is faulty training In such cases, careful education is needed The child must be encouraged to take an interest in her complaint and rewarded suitably for good behaviour On no account must she be punished or threatened for bed wetting In the first week or two of the treatment she should be wakened at two-hourly intervals to pass water Later the intervals are lengthened.

Retention of Urine. Retention of urine may result from many causes. The treatment is equally varied —

Mechanical Obstruction. Retention may result from stricture of the urethra, from prostatic disease, or rarely *from a blood clot or a*

mass of tumour blocking the internal meatus. The first step is to relieve any superadded spasm, and thus encourage urination, by applying fomentations to the lower abdomen, or placing the patient in a hot bath, or finally by giving a large enema. If these methods fail, an attempt is made to pass a catheter If this also fails, the bladder must be opened above the pubis, generally a self retaining catheter is introduced.

In the case of blood clot in the bladder the treatment is to evacuate the clot by lavage with hot saline through a large catheter

Paralysis Retention may result from paralysis due to injury of the spinal cord or to various diseases, such as tabes, disseminated sclerosis, spina bifida. In these conditions the use of a catheter is sometimes unavoidable Especial care is necessary to avoid infection

Atony Retention occurs quite often after operation in weak elderly patients, especially women and is an important cause of obscure ill health during the post-operative period. The retention is of gradual onset, and, since some urine continues to be voided at intervals, the condition may escape notice until the enlarged bladder is observed The treatment is to catheterise repeatedly until the bladder regains its tone. Carbachol (see below) is sometimes of value.

Atonic dilatation also occurs in children as a result of sympathetic imbalance similar to the colon dilatation of Hirschsprung s disease. The treatment, if other methods fail, is to perform presacral neurectomy

Spasm Retention from spasm is common after operation for piles, fissure and other painful conditions in the perineum. It also occurs in acute gonorrhoea and other painful conditions of the urethra. It may occur in hysteria. Finally there is a common though mild form which occurs in men of neurotic temperament, who may be unable to pass water in the presence of others. Such patients find difficulty in the use of a urinal in bed.

The treatment of spasmodic retention is, in the first place, to encourage normal micturition. The patient is allowed to stand, if possible, or to sit at a closet, or better still, in a hot bath. A large enema may be given. If these simple measures fail, Carbachol (carbaminoylcholine) or a similar preparation should be given in doses of 1 ml. intramuscularly It has a marked effect upon the plain muscle of the bladder and generally stimulates micturition within a few minutes. If it fails in fifteen minutes, a second or even a third dose may be given. Only if these measures fail should a catheter be passed.

CONGENITAL MALFORMATIONS

Congenital Obstruction at the Bladder Neck. This term is applied to a condition found in male children, in which for no obvious reason emptying of the bladder is impaired. In the course of time the bladder becomes more and more distended, until eventually there is complete overflow incontinence. As a result bilateral hydronephrosis develops and signs of renal impairment become manifest.

The condition has been attributed to congenital valves of the mucous membrane of the prostatic urethra, but the present tendency is to ascribe it to achalasia, the result of nervous imbalance in the control of the bladder

It is significant that no organic obstruction can be found, and a catheter passes into the bladder without difficulty

The treatment in the first place is to decompress the bladder gradually In some cases relief is afforded by presacral neurectomy which by dividing the "filling" fibres corrects the balance between the sympathetic and parasympathetic innervation.

Extroversion of the Bladder In this abnormality which results from atresia or rupture of the cloacal membrane, the anterior wall of the bladder and the anterior abdominal wall below the umbilicus are defective. There is a gap in the midline of the lower abdominal wall, through which the posterior wall of the bladder protrudes. It is recognised as an inflamed, rugose surface surmounted by two papillæ, the ureteral orifices from which urine is continually emitted. Usually there are other congenital defects too—epispadias, undescended testes, atrophy of uterus and vagina, absence of the pubic symphysis

Owing to the constant leakage of urine the condition is very distressing The treatment formerly was to transplant the ureters into the pelvic colon. This procedure, uretero-colostomy sometimes led to hyperchloræmic acidosis (owing to excessive electrolyte absorption) and also predisposed to ascending infection of the kidneys It is now thought preferable to establish an "ileal bladder" A segment of ileum 5 or 6 inches long is isolated, its blood supply being preserved. Continuity of the intestine is established by anastomosis. The ureters are implanted into one end of the isolated loop while the other end is brought out at the skin surface. Subsequently a bag is worn, similar to the ileostomy bag

Epispadias In this abnormality the penis is cleft, and the urethra *opens upon its dorsal surface. In some cases the orifice is close to the glans,* there are little deformity and no dysfunction, and no treatment is required. More often the orifice is close to the root of the penis In such cases a plastic procedure is sometimes attempted, but is rarely successful. If there is incontinence of urine, or if extroversion of the bladder co-exists the treatment is to transplant the ureters into the colon.

Hypospadias. In this condition the urethra opens on the under surface of the penis. The site of the orifice may be at the base of the glans at the under surface of the body of the penis or in the perineum. There is no incontinence and micturition can be carried out in a sitting posture without difficulty

No treatment is required in most cases. In the more severe forms a plastic procedure may be attempted.

RUPTURE OF THE BLADDER

This grave injury may occur as a complication of fracture of the pelvis, or if the bladder is distended, as a result of a blow on the abdomen. The rupture may be intra or extra peritoneal (Fig 247)

Intraperitoneal Rupture. This injury allows urine to flood the free peritoneal cavity The toxic urine is then absorbed and causes severe poisoning Sooner or later in addition, infection gains access and leads to an insidious but grave form of peritonitis. Infection is most likely to occur as a result of catheterisation unless the utmost care *is taken to* preserve asepsis.

At the time of the injury there is pain in the lower abdomen, and this is usually followed by severe shock. There is a desire to micturate, but no urine can be passed. Rupture of the bladder in crush accidents *may be masked by the magnitude of the other injuries,* while rupture

from a blow on the abdomen may pass unnoticed since it is usually sustained during intoxication.

The diagnosis is made by the fact that, although the catheter can be introduced without difficulty into the bladder, there is no escape of urine, or only a little bloodstained urine. Rarely the catheter penetrates through the tear and draws off several ounces from the peritoneal cavity

In the later stages the signs and symptoms of diffuse peritonitis appear

The treatment is to repair the injury without delay In addition, a self retaining catheter should be inserted to drain the bladder and the peritoneal cavity should also be drained.

Extraperitoneal Rupture. In this condition the symptoms and signs are similar but with the additional feature that the extravasated urine quickly becomes evident as a deep-seated swelling ascending into the abdominal wall from behind the pubes. The urine, being highly toxic, causes necrosis of the connective tissues with which it comes in contact. In addition a low-grade suppuration rapidly supervenes, giving rise to extensive pelvic cellulitis with marked toxæmia

The treatment is to open the bladder by the suprapubic route. If the tear is within reach it should be sutured, but if not it suffices to insert a drainage tube into the bladder In addition, the prevesical space, exposed at the lower end of the wound, should be widely drained. In most cases the cellulitis extends over the lower abdominal wall, and it is necessary to make multiple incisions into the subcutaneous and extraperitoneal tissues, packing the wounds widely open with eusol gauze.

Convalescence is prolonged, as the sloughs are very slow to separate.

RUPTURE OF THE URETHRA

Rupture of the urethra may be caused by a blow on the perineum, but much more often occurs as a result of fracture of the pelvis. In such an injury the urethra is sheared across in its membranous portion at the point where it passes through the inferior fascia of the urogenital diaphragm. The tear may be partial or complete in the latter case the two ends of the urethra may be widely separated.

Clinical Features. Rupture of the urethra is characterised by pain in the perineum and bleeding from the external meatus. There is a severe degree of shock, especially if the pelvis is fractured. In some cases there is complete retention of urine, in others attempts to pass water lead to extravasation rarely if the tear is a small one, micturition is unaffected.

On examination, there is marked tenderness on pressure over the urethra, and the whole perineum is greatly swollen and discoloured by effused blood.

If extravasation occurs the urine generally escapes from the urethra below the level of the urogenital diaphragm (Fig 247) It then infiltrates the tissues of the perineum and the scrotal wall and spreads up over the

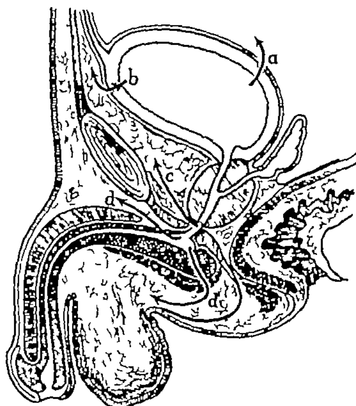


FIG. 247 Rupture of bladder and urethra. (*a*) Intraperitoneal rupture of bladder. (*b*) Extraperitoneal rupture of bladder (*c*) Rupture of membranous urethra. (*d*) and (*d'*) Rupture of bulbous urethra.

abdominal wall. It *is prevented from spreading posteriorly towards* the anus by the attachment of the fascia of Colles to the base of the urogenital diaphragm. Less *often* the *extravasation occurs* between the layers of the urogenital diaphragm (Fig 247) and the urine may



FIG. 248. Rupture of urethra, showing intense bruising in the perineum.

then infiltrate upwards round the prostate and infect the pelvic cellular tissues. If not promptly treated the extravasation leads to widespread cellulitis and severe toxæmia.

Treatment. The patient should be instructed not to pass water An attempt should then be made to introduce a rubber catheter, and if successful, the catheter should be tied in place If the catheter cannot be introduced, the ruptured urethra should be exposed and sutured The patient is placed in the lithotomy position and a staff or bougie is introduced as far as possible along the urethra. An incision is then made in the perineum on to the staff and the distal end identified The proximal end is then sought and the two ends sutured in place over a catheter If the proximal end cannot be found, an instrument should be passed down from the internal meatus to indicate its situation. Subsequently bougies should be passed at regular intervals to prevent stricture formation.

VESICO VAGINAL FISTULA

A fistula between the bladder or sometimes one ureter and the vagina is generally traumatic in origin the result of necrosis of the adjacent walls of the two viscera after the operation of hysterectomy

Occasionally it is caused by the prolonged pressure of the fœtal head in a difficult labour Less often it results from malignant disease of the bladder uterus or vagina.

The urine escapes from the vagina incontinently and causes much excoriation of the surrounding skin. Often infection gains access and causes cystitis sometimes with stone formation

The site of the fistula may be demonstrated by cystoscopy by direct inspection of the vagina, or by radiography after injecting an opaque fluid into the bladder

The treatment is to expose the fistula, separate the viscera, remove any diseased tissue and repair by suture. If this fails, transplantation of the ureters into an ileal bladder (p. 496) is indicated.

CYSTITIS

Predisposing Factors. The normal bladder is remarkably resistant to infection by pyogenic organisms, and cystitis is almost always dependent upon one of the following predisposing factors —

(1) Urinary stasis, due to such lesions as prostatic enlargement, stricture of the urethra, diverticulum of the bladder or atonic dilatation of the bladder In these conditions infection is very liable to be introduced by catheterisation. In women cystitis may occur in pregnancy It is a common complication of uterine prolapse with cystocele, a condition in which the base of the bladder being unsupported, sags towards the vagina.

(2) Foreign bodies in the bladder e.g stones or objects introduced along the urethra.

(3) Tumours of the bladder especially if ulcerated and partly necrotic.

(4) Gonococcal disease of the prostate and posterior urethra.

Acute Cystitis

Pathological Features. Acute catarrhal cystitis is the common form. The base of the bladder is mainly involved, and its *mucous* membrane is intensely congested and inflamed. In severe cases the vault of the bladder is also affected.

The infecting organism is generally *B coli*. The bladder may be infected secondarily to pyelitis, but more often the infection is introduced along the urethra. Women are especially liable to this disease, owing to the shortness of the female urethra. In some cases the infection is introduced by catheterisation.

Acute ulcerative cystitis is characterised by more marked changes. The whole bladder wall is inflamed and there are superficial ulcers, often covered with adherent deposits of phosphatic material (alkaline encrusted cystitis) This type of cystitis is generally due to such organisms as streptococci, staphylococci and *B proteus* Since some of them have the property of splitting urea, ammonia is set free and the urine becomes strongly alkaline. Infection of this character is seen most often in cases of marked urinary obstruction, treated by repeated catheterisation. The infection is very apt to ascend to the kidney and set up pyelonephritis.

Clinical Features. The onset of acute cystitis may occur suddenly after a chill or excessive indulgence in alcohol, or after passage of a catheter The symptoms are frequency of micturition, pain and urgency The frequency may be marked, with an urge to pass urine every few minutes. The pain is felt in the perineum and referred to the urethral meatus, and is most intense at the end of micturition, when the sensitive bladder base comes in contact with the internal *meatus. In catarrhal cystitis the urine is turbid and contains* a little pus and numerous organisms in ulcerative cystitis the pus is present in large amount, and, in addition, there may be blood in the urine.

Treatment. In cystitis due to B coli treatment by sulphonamides is highly effective. In most cases no other treatment is needed. If desired, a mixture may be prescribed, containing large doses of such alkalies as sodium bicarbonate, potassium citrate and acetate, and urinary sedatives such as hyoscyamus.

In other types of infection penicillin treatment is indicated if the organism is of sensitive type.

Chronic Cystitis

This infection may follow acute cystitis or may arise insidiously It is a common disease. In women it arises frequently as a complication of cystocele in men as a complication of gonococcal prostatitis, prostatic enlargement, urethral stricture.

Clinical Features. The symptoms are like those of acute cystitis, but milder There is frequency of micturition, especially diurnal, with urgency *of micturition and* pain on passing water The pain is felt in the perineum and at the urethral meatus. Often there are

exacerbations after a chill or an alcoholic bout. In severe forms of cystitis the general health is impaired

If the infecting agent is *B coli*, the urine is highly acid and turbid, and contains pus cells and numerous organisms. If there are such organisms as streptococci, staphylococci and *B proteus*, which commonly occur together, the urine is alkaline owing to their urea splitting action, and in most cases the pus is present in large amount.

Diagnosis. (1) Polyuria, e.g in diabetes, causes frequency of micturition but no pain

(2) Prostatic enlargement causes frequency, especially nocturnal, but in uncomplicated cases the urine is clear and uninfected

(3) Pyelitis causes frequency and the urine contains pus and organisms, but there may be pain in the loin, and the source of infection can be located to the one kidney by ureteral catheterisation

(4) Stone in the bladder causes pain and frequency but in un complicated cases the urine is sterile, and the stone may be demon strated by radiography and/or cystoscopy

(5) Tuberculosis of the kidney or bladder causes frequency but can be distinguished by a thorough bacteriological and cystoscopic investigation.

Treatment. The treatment is as for acute cystitis and is generally effective. In resistant cases much improvement may be obtained by washing out the bladder with such solutions as pot. permanganate (1/5 000) oxycyanide of mercury (1/5 000), or silver nitrate (1/10,000 to 1/5 000) After the bladder has been washed out, or as an alternative treatment, ½ oz. of argyrol may be instilled into the bladder starting with a 5 per cent. solution and increasing the strength to 10 per cent.

STONES IN THE BLADDER

Stones may arise in the normal bladder or more often, in the dilated bladder behind an enlarged prostate or a urethral stricture. Cystitis is an important predisposing factor in many cases.

The stones are composed of the same substances as those in the kidneys the majority consist of urates or phosphates. Quite commonly bladder stones have a laminated character and consist of a nucleus of calcium oxalate surrounded by alternating layers of urates and phosphates.

Clinical Features. Pain and frequency of micturition are the princi pal symptoms. The pain is referred to the perineum and the external urethral meatus, and characteristically comes on acutely at the end of micturition, when the stone is pressed against the sensitive bladder base. The frequency of micturition is due to irritation caused by the stone consequently it is worst on movement, especially on jolting movement, and subsides on resting

Hæmaturia occurs commonly The bleeding is most marked towards the end of micturition, as the stone is pressed against the bladder neck.

Difficulty in micturition, *strangury and sudden interruption* of the stream may also occur

Frequently a stone in the bladder is complicated by enlargement of the prostate or cystitis and the symptoms may be correspondingly confused Sometimes a further complication is an ascending urinary infection, leading to pyelonephritis

Diagnosis. The diagnosis is confirmed by radiography and by direct inspection of the stone through a cystoscope.

Treatment. The *stone may be crushed* by means of a lithotrite, an instrument shaped like a metal catheter terminating in two jaws which may be opened and closed by a screw adjustment. The crushed fragments are removed through an evacuator a large catheter connected with a rubber bulb and a glass container Alternate forcible contraction and relaxation of the bulb forces a stream of water into and out of the bladder and washes the fragments into the glass container Lithotrity (litholopaxy) is impracticable in the presence of urethral stricture, prostatic enlargement or severe cystitis. In some cases the stone is too large or too hard to be crushed.

If lithotrity cannot be performed the stone must be removed by the suprapubic route.

TUMOURS OF THE BLADDER

Papilloma and Papillary Carcinoma

These common tumours occur in adults, especially in elderly men In some cases the tumour is an entirely benign papilloma, but often, sooner or later, it becomes malignant and assumes the characters of a papillary carcinoma. This is especially so in elderly men

A simple papilloma is a villous growth, consisting of a core of connective tissue which branches and rebranches in delicate fronds surmounted by a thin epithelial covering of transitional type. It forms a somewhat pedunculated tumour, often an inch or so in diameter (Fig 249) Most frequently it is situated immediately above and lateral to one ureteral orifice

If the growth undergoes malignant change it becomes more sessile, spreads to the adjacent mucous membrane, and later infiltrates the bladder wall. In such cases daughter growths may appear in other parts of the bladder perhaps due to the engrafting of cells set free from the parent mass and numerous minute seedlings may appear in the adjoining bladder wall.

Clinical Features. Painless hæmaturia is the characteristic *symptom*. The bleeding often arises suddenly without obvious cause and is profuse. Often the blood is incompletely mixed with the urine and is most profuse towards the end of micturition as the vascular tumour is pressed against the bladder neck. The blood may clot in the bladder and cause pain and difficulty in micturition, and even complete retention.

Diagnosis. The diagnosis is made by cystoscopy which not only reveals the tumour but also shows its size, situation and extent.

Treatment. Electro-coagulation or fulguration is the method of choice A delicate insulated wire electrode, the size of a ureteral catheter, is inserted through the cystoscope and, under vision, brought into contact with the tumour The high frequency current, passing to a large ' indifferent " electrode strapped to the back or thigh, is con centrated at the tip of the " active " electrode and rapidly coagulates the growth.

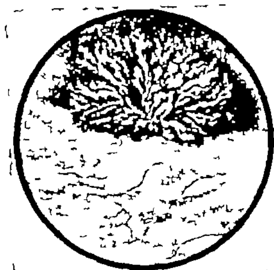


FIG. 249 Villous papilloma of the bladder as seen on cystoscopy

A small simple papilloma may be destroyed at one session. A papilloma with malignant characters must be fulgurated repeatedly and kept under observation at regular intervals for years, so that any recurrent nodule may be destroyed at an early stage.

Carcinoma of the Bladder

Carcinoma of the bladder includes the papillary carcinoma described above and nodular ulcerative, infiltrating growths. The latter vary in microscopic character some being spheroidal-cell carcinoma, others squamous epithelioma. They occur mainly in elderly men, and generally arise at the base of the bladder They infiltrate the bladder wall extensively and may involve one or both ureteral orifices. In some cases the tumour also involves adjacent viscera, e.g the prostate or rectum. Distant metastases are rare

Clinical Features. Hæmaturia is the first symptom in most cases. It comes on suddenly and may be profuse. The blood may be incompletely mixed with the urine, and is most profuse towards the end of micturition. Frequency is also an early symptom, especially if the tumour lies near the internal meatus. Pain is absent at first, but later is severe, owing to involvement of nerves by the infiltrating growth. Dysuria, strangury and retention of urine may occur Cystitis is a common complication, which adds to the misery of the later stages.

Diagnosis. The diagnosis is made on cystoscopy

Treatment. Carcinoma of the bladder is but little sensitive to radio-

therapy If the tumour is small and favourably placed it may be removed by the operation of partial cystectomy If it is large or inaccessible, operation is not usually practicable. Rarely if the tumour is large a total cystectomy may be performed. In such cases, and also as a palliative procedure in unresectable cases, the urinary stream may be diverted by transplanting both ureters into an isolated loop of ileum drained to the skin surface. Subsequently the patient is fitted with a detachable bag similar to that worn after ileostomy (p 418)

DIVERTICULUM OF THE BLADDER

This is a pouching or herniation of the bladder mucosa through a weak place in its muscular tunic. Multiple small diverticula or sacculations are common in severe degrees of urinary obstruction, but occasionally there is a single diverticulum which opens into the bladder by a small aperture close to one ureteral orifice.

The clinical features vary In some cases a large diverticulum gives no symptoms. Sometimes there are intermittent attacks of frequency of micturition, dysuria or retention of urine. Cystitis often develops and adds its own symptoms.

The diagnosis is confirmed by cystoscopy or by cystography—radiography after injecting an opaque fluid such as sodium iodide into the bladder

The treatment is to excise the diverticulum if possible. If not, it should be drained by a wide rubber tube inserted through a suprapubic cystostomy wound, and kept empty by constant suction.

STRICTURE OF THE URETHRA

Stricture of the urethra may occur as a sequel to rupture but is commonly a late result of gonorrhoeal urethritis

A traumatic stricture is situated at or close to the membranous urethra, and may be long or short, tight or lax, according to the extent of the damage. It is always single.

A gonorrhoeal stricture may be in the bulbous or penile portion of the urethra, and is often long, tortuous and tight. Frequently there are two or more strictures.

Clinical Features. The symptoms of a stricture appear very insidiously There is increasing difficulty in micturition, with delay in starting the act. The stream of urine is often forked and narrow There may be after-dribbling In some cases the induration can be palpated in the perineum in the line of the urethra.

The diagnosis is established by passing an olive-headed bougie. The stricture is recognised by its induration, which gives a characteristic grating sensation as the instrument is passed. Confirmation is obtained by urethroscopy

Treatment. (1) Dilatation with bougies is the treatment of choice in nearly all cases. It is as well to start with a bougie of moderate size,

and only if this fails should one of finer calibre be used to avoid the risk of forcing a false passage In difficult cases a fine bougie may be inserted through a urethroscope. The stricture should not be dilated too far at one sitting for the aim is to stretch the fibrous tissue, not to split it. The dilatation must be repeated at intervals, first of a few days, later lengthening to several weeks or months

(2) Internal urethrotomy is advised in rare cases for a short, tough stricture which resists gradual dilatation The urethrotome, a guarded triangular knife set in the side of a flexible bougie, is introduced along the urethra, and the stricture is thus divided Subsequently dilatation by bougies must be continued

PERI URETHRAL ABSCESS

A peri urethral abscess generally arises as a complication of stricture, rarely as a result of urethritis or of a stone in the urethra.

The abscess may be in the penis or in the perineum. It gives rise to a tender brawny swelling which later softens and bursts either into

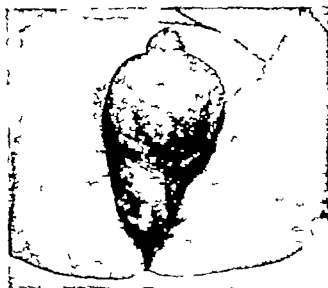


FIG. 250 Extravasation of urine resulting from peri-urethral abscess formation behind a stricture. Note how the swelling is limited posteriorly and at the sides by the deep attachments of Colles fascia.

the urethra or on to the perineum or in both directions. It is very apt to lead to extravasation of urine or to a urethral fistula.

The treatment of an abscess in the penis is to open it through a urethroscope. An abscess in the perineum should be opened from the skin surface.

EXTRAVASATION OF URINE

Extravasation of urine may result from rupture of the bladder rupture of the urethra, or a peri urethral abscess.

From the bladder (extraperitoneal rupture) or the posterior urethra, the urine infiltrates the pelvic cellular tissues and rises behind the pubes to the abdominal wall, from the bulbous urethra the urine infiltrates

the anterior part of the perineum (being restricted posteriorly by the attachment of the fascia of Colles to the base of the urogenital diaphragm) infiltrates the scrotum and penis, and spreads upwards in the abdominal wall (Fig 247)

The urine, being highly toxic, causes necrosis of the infiltrated connective and fatty tissues. In most cases the urine is also infected, or infection may gain access secondarily and thus a widespread cellulitis develops

Extravasation therefore gives rise to severe toxæmia. The temperature is raised the pulse rapid and weak, the tongue dry and furred, the features drawn and haggard. Rigors are common Often the patient is delirious Locally there is a brawny swelling of the affected tissues, which later gives place to loculated collections of pus. The overlying skin is discoloured and may be crepitant.

The treatment is to make multiple incisions freely in the affected areas, leaving the wounds packed widely open with eusol. In most cases the bladder must be drained above the pubes.

CHAPTER 44

THE MALE GENITAL TRACT

INFERTILITY

INFERTILITY may be attributable to the male or female partner On the male side, assuming that there is no impotence (or failure to complete the sexual act) the infertility may be due to failure in the production or transport or ejaculation of the sperm.

Failure in spermatogenesis may be due to obvious causes such as congenital abnormalities (e.g non-descent) of the testes or diseases such as the orchitis which complicates mumps or it may be due to hormonal disturbances such as hypopituitarism or genetic abnormalities such as Klinefelter's syndrome; or it may occur as a primary, idiopathic abnormality Failure in the transport of sperm may be due to diseases such as gonorrhoea which cause obliteration of the ducts of the epididymis, the vas deferens or the seminal vesicle. Failure in ejaculation may follow prostatectomy where interference with the internal sphincter allows the sperm to reflux into the bladder

Pituitary hormones (gonadotrophins) influence both the interstitial cells and the seminiferous cells of the testis. Failure of spermatogenesis may occur without other signs of hypopituitarism. The diagnosis is confirmed if the gonadotrophin content of the urine is diminished (as tested by injecting urinary extracts into young female mice and observing the resulting increase in uterine weight) The treatment is to administer gonadotrophic hormones.

Klinefelter's syndrome is a condition in which the testes are atrophic, and microscopically show complete destruction of the seminiferous tubules with overgrowth of interstitial cells. In many cases the patient, while outwardly of male configuration is a genetic female, in that his cells have the chromatin arrangement characteristic of the female There is no treatment.

Investigation of Infertility The male partner should be investigated first. Assuming that intercourse is normal and that there are no obvious defects such as testicular atrophy or hypospadias, he should be instructed to produce a specimen of semen, preferably by masturbation into a clean jar (a condom specimen may be spoilt by chemicals in the rubber) and to submit it for examination within two hours Normally it measures 3 ml. or more. It should be diluted 1 in 10 with a diluent containing sodium bicarbonate to dissolve the mucin, and examined at body temperature in a blood counting chamber Normally actively mobile spermatozoa should be present, in number from 50–200 million per c.mm. If repeated examination shows a deficiency of spermatozoa, search should be made for the various diseases mentioned above.

ACUTE PROSTATITIS AND PROSTATIC ABSCESS

The prostate may be infected by gonococci derived from the posterior urethra (p 84) or by staphylococci carried in the blood stream.

Staphylococcal Prostatitis. In this disease the infection may be derived from the throat or from a focus such as a boil. It occurs in adults, and *sometimes there is no history of previous ill health.* The attack starts abruptly with pain in the perineum and referred to the tip of the penis, and with frequency and difficulty in micturition. In some cases acute retention of urine is an early feature. The temperature is raised and there is a variable amount of malaise. There may be rigors.

Rectal examination shows the prostate to be swollen and very tender Later when suppuration occurs, the abscess is felt as a tense or boggy mass The urine may be clear or contain scanty pus cells and organisms.

The diagnosis is to be made from gonococcal prostatitis by the absence of any sign of anterior urethritis and by isolation of the causative organism.

The treatment is to administer penicillin. Morphia may be required to still the pain. If acute retention develops, catheterisation may be unavoidable. The abscess usually bursts into the urethra and the disease then quickly clears up.

CHRONIC PROSTATITIS

This is generally a sequel to acute prostatitis. It may be gonococcal or staphylococcal in origin. Generally there is a feeling of weight in the perineum, with frequent and sometimes painful micturition. There is usually a urethral discharge, especially after defæcation. Painful erections may occur or there may be impotence or sexual incontinence.

Examination reveals the prostate enlarged and a little tender with boggy areas in one or both lobes The seminal vesicles are often distended with stagnant secretion. The urine contains threads of mucopus. On prostatic massage, a quantity of exudate containing pus cells and organisms can be expressed into the prostatic urethra.

Chronic prostatitis may respond to treatment with penicillin, supplemented if necessary by sulphonamides. In addition prostatic massage may be performed In resistant cases large bougies should be passed to stretch the orifices of the prostatic ducts in the posterior urethra.

PROSTATIC CALCULUS

Multiple small concretions may form in the ducts and within cavities in the gland as a result of long-continued mild prostatitis. They occur especially in elderly men and give rise to symptoms like those of simple prostatic enlargement. On rectal examination the gland feels stony hard, *and the mistaken diagnosis* of carcinoma is very apt to be made.

The diagnosis is made by radiography, which shows a number of small, rounded dense shadows grouped together a little way behind the pubes.

The treatment is to remove the stones, together with the affected part of the prostate, preferably by the perineal route

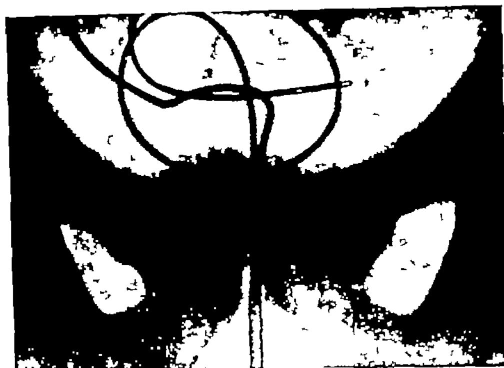


Fig. 251 Prostatic Calculi. A mass of small calculi is seen behind the symphysis pubis. Ureteral catheters have been passed.

SIMPLE ENLARGEMENT OF THE PROSTATE

This disease is rare before the age of 60 years, and is increasingly common at later ages. It is characterised by overgrowth of the fibro-muscular and glandular elements of the prostate, the overgrowth taking the form of one or more nodules or "adenomata," which commonly attain the size of walnuts, and in rare cases grow much larger It is doubtless hormonal in origin but the precise cause is unknown.

The "adenomata" are found most often in the middle lobe (the part of the prostate between the ejaculatory ducts and the bladder base) or in the lateral lobes. In enlarging, they compress the overlying prostatic tissue and thus become encapsulated. In removing the adenomata it is important to enucleate them from within their capsules, leaving the unaffected portions of the gland intact.

If the middle lobe is involved, the adenoma projects up into the bladder as a small rounded eminence immediately posterior to the internal meatus. In doing so it stretches the internal sphincter and impairs the emptying mechanism of the bladder (p 498) If the lateral

lobes are involved, the projection into the bladder takes the shape of a collar almost completely surrounding the internal meatus.

Effects of Prostatic Enlargement. The enlarging prostate exerts secondary effects on the urethra, bladder ureters and *kidneys*:—

The urethra becomes elongated and more curved than normally owing to the upward growth of the prostate. The bladder hyper

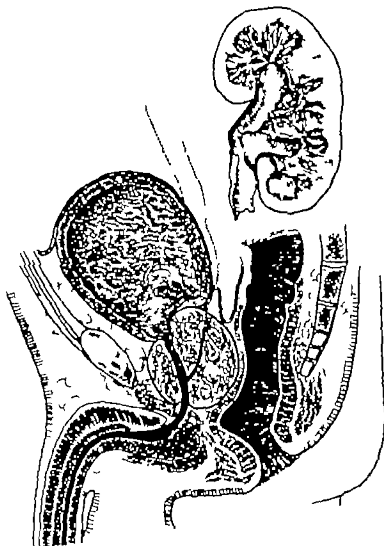


FIG. 252. Simple enlargement of the prostate. The bladder is hypertrophied, trabeculated and dilated. The ureters are dilated and the kidneys hydronephrotic.

trophies to overcome the urinary obstruction and later dilates, with progressive increase in the amount of residual urine. Eventually the ureters and kidneys also suffer dilatation from back pressure.

Complications. (1) Chronic retention of urine is of common occurrence, leading to bilateral hydronephrosis and impairment of renal function.

(2) Acute retention of urine may occur early or late in the course of the disease. It is apt to occur if the bladder has been allowed to over

distend, or following acute congestion of the prostate from a chill or alcoholic excess.

(3) Hæmaturia may result from prostatic congestion The bleeding usually comes from a dilated vein on the vesical surface of the prostate and may be profuse. Generally the blood is not completely mixed with the urine, and is most in evidence towards the end of micturition when the bladder contracts on the vascular prostate. Clots may form in the bladder causing acute pain and strangury

(4) Urinary calculi may form in the bladder

(5) Infection may gain access, especially after catheterisation and lead to cystitis, epididymitis or ascending pyelonephritis

Symptoms. The symptoms bear little relation to the degree of enlargement. In some cases they arise early and are severe, in others they are mild though the prostate is immense.

Frequency of micturition is the commonest symptom The frequency is both diurnal and nocturnal. In severe cases it necessitates rising from bed three or four times during the night.

Difficulty in micturition (dysuria) develops in some cases At first there is a short delay in starting to pass water Later the patient has to stand and strain for a considerable time, while in some cases the flow of urine is interrupted, perhaps for several minutes. Eventually chronic retention of urine may supervene, with incomplete emptying of the bladder Acute retention may occur at any time.

In some cases hæmaturia is an early sign while in others attention is drawn to the disease by the occurrence of sexual incontinence, which may lead to the commission of indecent offences.

Examination. (1) Digital examination *per rectum* will demonstrate enlargement of the prostate (excluding rare cases in which the entire enlargement is intra vesical) The simple adenomatous prostate is firm or elastic and uniform in consistency The presence of hard nodules suggests carcinoma.

(2) A thorough clinical examination is necessary to assess the patient s general condition. The nervous system should be examined with special care to exclude nervous diseases simulating prostatism (p. 493) The cardio-vascular system, often involved in renal disease, must be examined. The blood pressure should be estimated. Signs of renal impairment should be sought. On abdominal examination enlargement of the kidneys and distension of the bladder may be recognised.

(3) The urine should be submitted to routine examination for albumen, sugar casts, pus cells, organisms. Its specific gravity must be recorded and the quantity secreted in twenty four hours estimated.

(4) Cystoscopy is valuable to confirm the diagnosis and to exclude other lesions, e.g stone or a diverticulum of the bladder The cystoscope should be inserted immediately after urination to determine the amount of residual urine. On inspection of the bladder middle lobe hypertrophy will be recognised as a smooth rounded prominence in the midline just behind the internal meatus, while lateral lobe hypertrophy will form a collar almost encircling the internal meatus.

(5) Renal function tests are of value in assessing prognosis and determining the appropriate treatment. The blood urea estimation is most useful and a figure over 40 mg per 100 ml. indicates improved function. The findings must be interpreted in the light of a thorough clinical examination, with due regard to the cardio-vascular *system and* the general appearance of the patient.

(6) Intravenous pyelography will demonstrate any hydronephosis.

Diagnosis Simple enlargement of the prostate must be diagnosed from other prostatic lesions—chronic prostatitis, prostatic fibrosis, carcinoma from other causes of frequent micturition—diabetes mellitus or insipidus, polyuria due to chronic nephritis with high blood pressure, various nervous diseases (p 498) from other causes of retention of urine (p. 494)

Treatment. Since prostatic disease is not necessarily progressive, operation should not be advised unless clearly indicated. The main indications are incomplete emptying (as judged by residual urine), marked frequency of micturition, and acute retention. In other cases, especially in elderly men, the progress should be watched at three-monthly intervals with conservative treatment. The diet should be bland and free from highly spiced foods, alcohol should be avoided, constipation prevented and care taken to guard against a chill. The *urge to pass water must never be denied, lest over-distension occur*

Prostatectomy This is the routine treatment at the present time. Usually it is carried out at a single stage, but where there is retention of urine of long duration, especially if the renal function tests indicate severe damage to the kidneys, preliminary drainage of the bladder by suprapubic cystostomy is desirable.

The operation of prostatectomy is generally performed by the suprapubic route. To prevent epididymitis, formerly a common and severe complication, it is usual to ligate and divide the vasa efferentia. This is done through tiny incisions in the scrotum. Various operative techniques are in use. In a typical one, after the bladder has been opened the index finger is inserted into the prostate urethra to " burst the prostate from within. It is then an easy matter to shell out the individual adenomata. Under direct vision, using a special retractor hæmostasis is secured by fine catgut stitches or by diathermy A Foley catheter is inserted and finally the bladder is closed and the wound sutured. The catheter is left in place four or five days. Copious drinks are administered. Some bleeding is usual for the first few days. When the catheter is removed normal micturition follows at once, though with some pain and urgency for a short time. Alternatively the retropubic route may be used in which after incision through the lower abdominal wall the access is deepened behind the pubis and thus directly down on to the prostate.

Per urethral Resection. This method must be reserved for experts, *and is favoured* particularly in fibrous prostatitis or when the prostate is not much enlarged. Two methods are in vogue. Some urologists use a resectoscope," a modified cystoscope carrying a fulguration wire

electrode in the form of a loop by means of which V shaped fragments of the prostate can be removed Others prefer a 'cold punch a slotted sheath with a sharp-edged obturator which is passed along the urethra and used like a ticket punch to remove cylindrical portions of the prostate.

Whichever method is adopted the risks of open bladder drainage are avoided, and the patient is confined to bed for only a few days, though several sittings may be required

Treatment of Acute Retention If hospital facilities are available and the patient's general condition permits, it is now believed that the best treatment is to proceed immediately to perform prostatectomy Alternatively a catheter must be passed with every aseptic precaution A rubber catheter should first be tried then a catheter of plastic material. It is rarely necessary to use a metal catheter or to perform suprapubic puncture.

Treatment of Chronic Retention In chronic retention, with much residual urine and often serious effects from back pressure on the kidneys, careful treatment is necessary to avoid precipitating uræmia or introducing infection Some surgeons recommend continuous catheter drainage for several days. Strict asepsis is necessary and an antibiotic such as sulphamerazine should be given In severe cases a 2 stage procedure is necessary A tube is inserted to drain the bladder through a suprapubic puncture when perhaps after several weeks, the general condition permits, the prostate is removed in the usual way Special care must be taken to maintain a high fluid intake to ensure a urine output of at least 100 oz. in the twenty four hours

PROSTATIC FIBROSIS

In this condition the gland is atrophic and fibrous. It constricts the prostatic urethra and thus obstructs the outflow of urine. In some cases an unyielding fibrous ridge develops at the internal meatus—"median bar

The symptoms are similar to those of simple prostatic enlargement. Examination of the rectum shows the prostate to be small and hard, with almost the induration of a carcinoma. Cystoscopy confirms the diagnosis.

The treatment in favourable cases is by per urethral resection

MALIGNANT DISEASE OF THE PROSTATE

Carcinoma. Carcinoma of the prostate usually takes the form of a scirrhous growth, which soon infiltrates the surrounding tissues and spreads to lymph glands and to the bones of the pelvic girdle and spine. It may arise in a normal prostate or in one already affected by simple hypertrophy

The growth generally starts in the posterior part of the gland and it leads to progressive stenosis of the urethra. In most cases the prostate

is enlarged nodular and stony hard Rarely the *primary growth is* very small even at a late stage when multiple metastases are present.

The symptoms in the early stages are like those of simple prostatic hypertrophy with frequency of micturition diurnal and nocturnal and some difficulty in starting to pass water A distinctive feature, however *is that pain occurs early and becomes* progressively more severe. The pain occurs apart from micturition and is of a dull aching character Later when the pelvic nerves are infiltrated there are severe neuritic pains referred to the penis, perineum, back and thighs

Chronic retention of urine is a constant feature acute retention may develop at any time and infection of the urinary tract may supervene. Involvement of the rectum may lead to intestinal obstruction

The diagnosis is to be made from simple prostatic enlargement by rectal examination which reveals the prostate asymmetrically enlarged nodular and stony hard Prostatic calculi may be excluded by radiography which also may show metastases in the pelvic bones, visible as decalcified areas or as a diffuse mottling with sclerosis.

Two lines of treatment are available, both palliative If retention is *present or threatened, per urethral resection is useful, the aim being* not to remove the whole growth but to maintain the patency of the urethral channel

The second line of treatment is to administer stilbœstrol, or preferably dienœstrol of which the dose is 1 mg daily by mouth.

This treatment is *effective in reducing the pain especially of bone* metastases, and may delay the progress of the growth It may cause painful swelling of the breasts, and the pain may be so severe as to necessitate stopping the œstrogen treatment. In such cases castration should be performed as this procedure may influence the progress of the growth

Sarcoma Sarcoma of the prostate is a rare disease, which may occur at any age. Spindle-cell and round-cell sarcoma are described and also a mixed tumour or rhabdomyosarcoma. The gland becomes greatly enlarged and causes obstruction to the outflow of urine Hæmaturia is an important feature and pyuria may result from secondary infection. Metastases develop in the lungs and other viscera.

In most cases the only treatment is by palliative measures. Radium therapy is occasionally indicated

PHIMOSIS

Normally the prepuce at birth is partially fixed to the underlying glans penis by soft adhesions, which gradually resolve in early infancy

Phimosis results when the prepuce is too long and with too narrow an orifice, so that it cannot be retracted from the glans. In such cases the subpreputial adhesions persist and add to the difficulty Generally a mild degree of phimosis disappears in adolescence as the prepuce

gradually stretches, but in severe cases it persists and may lead to paraphimosis. Rarely a severe degree of phimosis is associated with marked narrowing of the external urethral meatus—a "pin hole meatus"—which in later life may lead to difficulty in micturition, culminating in acute retention

In adults phimosis may develop as a result of contraction of the prepuce due to gonorrhœa or balanitis.

Complications. *Phimosis predisposes to retention of smegma under* the foreskin, and thus to balanitis. If tight, the phimosis may cause retention of urine or lead to paraphimosis. Rarely in later life it predisposes to carcinoma of the penis.

Treatment. In infants it has been recommended to stretch the prepuce by the blades of a hæmostat, but though this at the time is successful, recurrence is common. Generally, if the prepuce is long and tight, the operation of circumcision should be performed Within a few weeks of birth it may be done without anæsthesia, or ether may be given if preferred The free edge of the prepuce on the dorsal aspect of the penis is held in a forceps and the prepuce is then divided obliquely, removing from ½ to ¾ inch, mainly from the dorsal part. The common mistake is to remove too much skin Care must be taken to avoid damaging the glans. The prepuce can then be retracted, the skin on its deep aspect being separated from the glans, to which it is adherent. Hæmostasis is then secured, and the covering and deep layers of skin are united by a few sutures.

In adults circumcision should be performed similarly unless in the presence of balanitis or urethritis, when it is preferable merely to remove a wedge from the dorsal aspect of the prepuce ' dorsal split ' so as to permit of its retraction, deferring the remainder of the operation until the infection has settled.

PARAPHIMOSIS

This is a complication of phimosis which occurs mainly in young men after coitus. The tight prepuce, forcibly retracted, constricts the corpus cavernosum penis and leads to marked swelling of the part beyond the line of constriction. If neglected it may cause ulceration of the penis at the line of constriction, or even lead to gangrene of the tip

Treatment. Hyalase solution (1 to 2 ml.) injected at two or three points in the œdematous foreskin will quickly reduce the œdema and enable the phimosis to be reduced. If hyalase is not available the part should be compressed in a cold wet pad of wool until the œdema has been dissipated. Circumcision should be performed later to prevent recurrence.

BALANITIS

This is an inflammation of the under surface of the prepuce and of the skin covering the glans. It may be due to (1) irritation of retained smegma behind a tight prepuce, (2) preputial concretions, which are

themselves due to inspissated smegma and mucus behind a tight prepuce (3) syphilis, gonorrhœa or soft sore in a patient with a tight prepuce.

Balanitis gives rise to pain in the affected region, and to a purulent, often foul smelling, discharge from under the prepuce. On examination, the prepuce is seen to be swollen and inflamed. In most cases it cannot be retracted from the glans.

If the balanitis is severe it may lead to perforating ulcer of the



FIG. 253. Balanitis with perforation of the prepuce in a man aged 75, who had long suffered from irritation due to inspissated smegma and concretions behind a tight prepuce.

prepuce (Fig 253) to cellulitis spreading in the substance of the penis to the abdominal wall, or even to gangrene of the penis.

The diagnosis is to be made from carcinoma of the penis, and from such specific infections as syphilis, gonorrhœa or soft sore.

The treatment is to split the prepuce on its dorsal aspect, so that it can be retracted, and to apply hydrogen peroxide, eusol, or mercuric lotions to the inflamed surfaces.

TUMOURS OF THE PENIS

Simple Tumours A simple papilloma may take the form of a wart or a hard, horny structure. The former is to be diagnosed from an infective or venereal wart, the latter from a carcinoma. The treatment is to excise the growth.

Carcinoma. The common form is a squamous epithelioma arising from the skin on the deep surface of the prepuce or the surface of the glans. It occurs in elderly men, especially in cases of long-standing phimosis, and is believed to result from the chronic irritation of retained smegma. It does not occur in circumcised men.

The symptoms are insidious in onset. Pain is not severe at first, and

the growth may remain unobserved if hidden under a tight prepuce. When ulceration occurs there is a bloodstained and often foul smelling discharge from below the prepuce.

On examination, there is an indurated mass of stony hard consistence under cover of the prepuce. Often there are palpable glands in one or both groins, enlarged from secondary infection or by metastatic growths.

The treatment in an early case is to amputate the penis, either partially or completely In the latter case a urethral orifice must be



FIG. 254. Carcinoma of penis arising in warty growth of three years' duration.

established in the perineum In late cases radium should be used If the growth is not too far advanced, the glands in both groins should be removed.

DISEASES OF THE TESTIS AND EPIDIDYMIS

Examination

The patient should preferably be examined standing before the surgeon, who is seated. After a preliminary general examination and inspection of the external genitals, the following routine should be carried out.—

(1) The scrotum is examined for an ulcer or sinus (suggestive of tuberculosis)

(2) The scrotal contents are palpated carefully comparing the affected with the other side throughout. The body of the testis is first palpated, its size shape, consistence and weight being noted Tenderness on palpation is noted, and finally the testis is gently pressed in order to elicit the characteristic testicular sensation. The *epididymis*, which normally lies posterior to the testis, is then palpated similarly

The vas deferens, which normally feels like a whipcord, is rolled between finger and thumb and compared with its fellow to determine any thickening or nodules indicative of tuberculosis.

(3) The tunica vaginalis is examined for the presence of fluid—a hydrocele (p 525)

(4) The veins in the pampiniform plexus are examined for varicocele (p 524)

(5) The inguinal canals and femoral regions are examined for hernia.

(6) The rectum is examined e.g for enlargement of the prostate and vesicles, and the urethra and penis for evidence of gonorrhœa or syphilis.

Undescended and Ectopic Testis

The testis develops in the retroperitoneal tissues of the lumbar region, and later descends to the scrotum. Its descent is generally attributed to a band of plain muscle and fibrous tissue known as the gubernaculum, which is attached to its lower pole and to the foot of the scrotum As the fœtus elongates and the gubernaculum contracts, the testis is guided to the internal ring along the inguinal canal, and finally into the scrotum. A pouch of peritoneum is drawn down on the antero-lateral aspect of the testis This is the vaginal process, which subsequently becomes shut off from the peritoneal cavity and forms the tunica vaginalis

Normally the testis begins to descend during the fifth month of fœtal life and gains the scrotum shortly before birth. The descent may be delayed or completely arrested, or the testis may be directed to various abnormal situations. These errors are generally attributed to atrophy of the gubernaculum or to developmental variations in the lower attachment of that structure.

Complications. Congenital inguinal hernia is common, owing to the persistence of the processus vaginalis. Less often a hydrocele develops. An undescended testis is liable to injury especially if situated in an exposed position in the groin and is very liable to torsion. Lastly it is said to be especially liable to malignant disease.

The Testicular Function. An undescended testis in a child is smaller than normal, and is often separated from the epididymis by a long fold of tissue or mesorchium. The scrotum also is of small size.

After puberty the testis fails to develop and remains small, soft and atrophic. Spermatogenesis nearly always fails to occur consequently if both testes are affected, sterility may be expected though not impotence. In exceptional cases, however a patient with bilateral undescended testis proves fertile. The internal secretion of the testis may be unaffected and the secondary sexual characters are little impaired

The cause of the testicular dysfunction has been a subject for much discussion. The general view is that the testis is normally formed, but atrophies as a result of its abnormal position. It has been claimed that spermatogenesis is influenced by temperature, and that the lower

temperature of the scrotum is the important factor that is lacking The opposing view which though not fashionable has much to commend it, is that the testis is imperfectly formed and that it fails to descend because it is atrophic.

Treatment. It is important to remember that in a young child, as a result of cold or apprehension, the testes may be retracted into the inguinal canal by spasm of the cremaster muscle. To avoid this the examining hand should be thoroughly warm, and the examination must be carried out gently

From the point of view of treatment, it is important to recognise two distinct types of undescended or ectopic testis.

(1) Undescended testis. The testis is in the normal pathway of descent but has failed to come down There are different degrees, in the most severe, the testis is retained within the abdomen, in the least severe it lies close to the external ring The testis tends to be small, soft and atrophic, but it may enlarge under hormone therapy In milder varieties of this type the testis will descend normally after birth, or even as late as puberty

The treatment of this type depends upon the age of the boy Under the age of 8 years, no treatment is necessary The parents are advised that spontaneous descent may occur If at 8 to 10 years there is no sign of spontaneous improvement, hormone treatment may be advised

The gonadotropic hormone Pregnyl has been widely used for this purpose. Six injections of 200 units are made at weekly intervals, and if no benefit results after an interval of a few weeks a similar course of injections of 500 units may be given. The hormones cause the secondary sexual characters to develop somewhat precociously, and must therefore be used with caution.

If hormone treatment fails or is contra indicated, the operation of orchidopexy should be advised. At operation it is found that the vas deferens is sufficiently long, and after the coverings of the cord have been divided the main obstacle to placing the testis in the scrotum is shortness of the internal spermatic artery This is overcome by mobilising the artery up to its origin from the aorta. On no account must it be divided for atrophy of the testis will certainly follow

When the testis has been replaced in the scrotum, it can be retained there by a variety of procedures. The one in most common use is the Thorek operation, in which the testis, with its pedicle intact, is drawn through an incision in the foot of the scrotum and implanted under the deep fascia of the thigh, the scrotum being sutured to the thigh like a tube pedicle. After several months the testis is finally restored to its proper site.

The functional results of this operation are unproven. Usually the testis remains atrophic and useless. The ultimate test—*paternity*—is meaningless in unilateral cases and highly suspect in bilateral cases.

In older patients (over 18 or 20) with unilateral defect, the un descended testis should be *removed*, to obviate torsion or trauma. In older patients with bilateral defects no treatment is of value.

(2) Displaced or ectopic testis. Here the testis, having traversed the inguinal canal normally has been displaced, perhaps by some abnormal band or adhesion, to an abnormal situation. The usual one is the superficial inguinal position, where the testis lies in the subcutaneous tissue just lateral to the external ring More rarely the testis lies near the root of the penis or even in the perineum.

Such a displaced testis is quite normally developed It can be distinguished by the fact that it is readily palpable and almost normal in size, whereas the undescended testis proper is usually too small and soft to be felt. This displaced testis, moreover has both a vas and a vascular leash of normal length, so it can be dissected up and placed in the scrotum without difficulty Operation is always needed in this type of case, and it can be done at any time between the age of 5 years and puberty

TORSION OF THE TESTIS

If the testis, either alone or with the epididymis, is suspended within the tunica vaginalis by a *mesorchium, it is liable to undergo torsion or* volvulus. This condition is especially apt to be present in an undescended testis.

The volvulus arises at any time of life, especially at about puberty It may be attributed to an injury or to spasm of the spirally distributed cremaster fibres. It may become reduced spontaneously in mild cases, but is very apt to recur

When a complete volvulus occurs the venous return is impeded, the testis becomes plum-coloured from extreme congestion, and the tunica vaginalis becomes distended with bloodstained exudate. Necrosis of the testis results and infection may supervene.

The onset is sudden There is acute pain, accompanied by nausea and vomiting and sometimes difficulty in micturition. The testis is *retracted* by muscle spasm and is swollen and acutely tender Its shape is obscured by the surrounding exudate. In some cases the abdomen presents reflex rigidity and the thigh is flexed.

The diagnosis must be made from acute epididymo-orchitis and from strangulated hernia.

The treatment is to expose the testis without delay undo the torsion and anchor the testis so as to prevent recurrence. If the testis is not viable it must be removed.

ACUTE EPIDIDYMO-ORCHITIS

Acute infections, whatever their cause, involve both the epididymis and the testis, though in varying degree. In general, an infection gaining access *via* the vas mainly affects the epididymis, whilst a blood borne infection may mainly involve the testis. The former group includes epididymitis secondary to infections of the urethra and bladder the latter includes the orchitis of mumps and other rare forms.

Infective ("Non-specific") Epididymitis. This is usually due to infection of the bladder and urethra with *B coli* It is a common complication of prostatectomy and it may follow catheterisation Formerly epididymitis was a well recognised complication of gonorrhœa.

The onset is abrupt, with pain in the testis and referred to the groin. The temperature rises, there may be a rigor and there is considerable malaise, sometimes with nausea and vomiting On examination, the scrotum is swollen, red and œdematous. Often a small "sympathetic" hydrocele is present. The testis and epididymis are swollen indurated and brawny, and very tender on pressure. The spermatic cord is thickened and tender, and often there is tenderness and pain in the lower abdomen

The treatment is to keep the man in bed with the testis elevated, and to give antibiotics. Rapid improvement is usual.

Orchitis in Mumps. This affection occurs mainly in young adults or adolescents, and generally arises a few days after the onset of the parotitis. Occasionally the salivary glands are not affected, and the only indication of the cause is the fact that the orchitis arises during a mumps epidemic.

The testis is swollen and painful, and the epididymus is also affected though to a less extent. In 30 per cent. of cases both testes are involved. Not uncommonly the testis subsequently undergoes atrophy

The treatment is on conservative lines, as described above.

TUBERCULOUS EPIDIDYMITIS

This disease, formerly common, is usually secondary to tuberculosis in the urinary tract. The corresponding seminal vesicle is constantly involved.

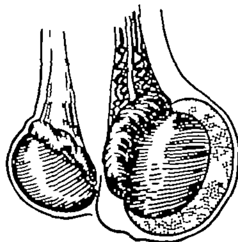


FIG 255 Tuberculosis of epididymis with small "symptomatic" hydrocele.

In chronic cases there are firm rounded nodules, perhaps the size of cherries, which may persist indefinitely causing no symptoms. In more active cases the disease spreads to adjacent structures (1) to the skin, forming a sinus discharging tuberculous pus (2) to the tunica vaginalis, forming a "sympathetic" hydrocele (3) to the vas deferens,

which becomes thickened and nodular (4) to the seminal vesicle, which becomes enlarged and (5) finally to a small extent, to the testis.

Clinical Features. Tuberculous epididymitis arises insidiously and is painless. On examination, the testis is normal in size and shape and retains its characteristic sensation Posteriorly, and partly enclosing the testis, is the enlarged cowl-shaped epididymis. Often the skin at the back of the scrotum is adherent. and a discharging sinus may be present. Rarely the sinus appears at the front of the scrotum this is



FIG. 256. Tuberculous epididymitis with cold abscess and sinus in a man aged 62, who also had tuberculosis of the kidney Generally the sinus appears on the posterior aspect of the scrotum. In this case the abscess had tracked forwards from a focus in the enlarged, forward projecting globus major

especially apt to occur if the epididymis is anteverted. The vas deferens should always be rolled between the fingers and compared with the normal side. Nearly always it is thickened and nodular

As a routine the rectum should be examined for enlargement or nodularity of the vesicles the opposite testis and epididymis must be palpated carefully the urine should be examined for tubercle bacilli and finally a thorough general examination should be carried out in search of other tuberculous foci.

Diagnosis. The diagnosis of tuberculous epididymitis should present no difficulty Syphilis and testicular tumours are excluded by the fact that the testis feels normal and retains its sensation. Cysts of the epididymis are smooth and tense and non adherent. Gonococcal and other forms of epididymo-orchitis are more acute in onset and more painful. Rarely confusion is caused by a mild non-specific epididymitis.

Treatment. If there is active tuberculosis in the lungs or other sites, conservative treatment by antibiotics is indicated.

If there is no other active lesion, operation should be advised after a preliminary period of conservative treatment. In favourable cases the operation is an epididymectomy The scrotal skin is incised round

the sinus, if one is present, and the epididymis is separated from the testis. It is then removed, along with the vas deferens, whilst the testis with its vascular pedicle is preserved.

SYPHILITIC ORCHITIS

In this rare affection the testis undergoes gummatous induration, and becomes large hard and adherent. The disease is painless throughout. The diagnosis is to be made from a tumour and from hæmatocele. Since the disease is now extremely rare it has lost its former importance.

TUMOURS OF THE TESTIS

Tumours of the testis are rare. Almost all of them are highly malignant, and despite early operative treatment, the majority give rise to metastases in the para-aortic regional glands and prove fatal

The following types of tumour occur—

(1) *Seminoma spermatocytoma.* This tumour formerly regarded as a sarcoma, is now known to be of epithelial origin, from the cells lining the tubules. The tumour is of firm, solid white character and may eventually attain considerable size

(2) *Mixed tumours* containing tissues derived from two or three of the germinal cell layers. The commonest in this group is the *tridermal teratoma*, which on microscopic examination is seen to contain tissues of great variety derived from ectoderm, mesoderm and entoderm. This tumour is often cystic. Rarer tumours in this group are the chorion epithelioma, a small, highly malignant tumour similar to the growth occurring in the uterus and the dermoid cyst of the testis, one of the few non malignant growths in this situation

Clinical Features. Tumours of the testis generally arise in young adults. There is a painless, insidious enlargement of the testis, which is smooth and of normal shape, firm in consistency or partly cystic. In the later stages there may be a "symptomatic" hydrocele. Often the growth is distinctly heavy The testicular sensation is retained in the early stages, but later is lost.

Metastases arise in the para aortic glands at the level of the origin of the internal spermatic arteries. They give rise to a large fixed retroperitoneal tumour situated above the level of the umbilicus and partly under the corresponding rib margin Only in the late stages, when the scrotal skin is involved, are the inguinal glands involved

Diagnosis. In some cases, especially in teratomata, additional evidence is provided by the fact that the Ascheim Zondek reaction, as used for pregnancy tests, is positive. For this test the urine may be submitted, or better the fluid from the hydrocele if present.

A tumour is distinguished with difficulty from the rare syphilis of the testis. A positive Wassermann reaction supports the diagnosis. Finally the diagnosis must be made from hæmatocele. This is often a matter of difficulty unless there is a clear history of injury e.g in puncturing a hydrocele.

Treatment. Orchidectomy is indicated in all except far advanced

cases. Some surgeons also advise clearance of the para-aortic ; exposed through an oblique incision medial to the anterior s spine, the peritoneum being retracted medially Post-operativ X ray therapy should be advised

CYSTS OF THE EPIDIDYMIS

Several types of cyst arise in relation to the epididymis. (1) M cysts develop in elderly men, forming tense, rounded, painless, lucent swellings on the posterior aspect of the testis. They c clear, watery fluid The treatment is to excise the individual cy the whole epididymis. (2) A spermatocele is a unilocular cyst

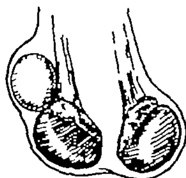


Fig. 257 Cyst of epididymis.

epididymis, filled with cloudy fluid containing spermatozoa. generally develops in the upper pole of the epididymis and give to a small, painless, translucent swelling It may be excised. cyst of the hydatid of Morgagni may occur It forms a grape pedunculated, translucent swelling attached to the upper pole o epididymis. It may be excised.

VARICOCELE

This is a varicose condition of the veins of the pampiniform pl It occurs nearly always on the left side, and is seen most often in y men. In severe cases the veins are visibly dilated and may be to be thickened and tortuous, "like a bag of worms" (Fig 258)



Fig. 258. Operation for varicocele. spermatic cord has been expos the external ring; veins of pampiniform plexus have been prior to removal.

Varicocele is generally attributed to congenital laxity of the venous walls. Its occurrence on the left side is variously ascribed to the dependent position of the left testis, to pressure of the pelvic colon on the left internal spermatic vein, or to the mode of entry of the vein into the left renal vein, at right angles to the flow of blood. None of these explanations convinces. In elderly men varicocele occasionally develops as a result of occlusion of the internal spermatic vein by a tumour of the kidney or adrenal gland

Varicocele usually gives rise to no symptoms and requires no treatment. Occasionally it causes a dragging or shooting pain in the groin and testis. It has been blamed for infertility and treatment is more often demanded for this reason The simplest procedure is to ligate the greater part of the plexus at the subcutaneous ring to remove about an inch of the ligated portion, and to attach the lower ligated end to the ring in order to support the testis.

HYDROCELE

This is a collection of clear straw-coloured, albuminous fluid in the tunica vaginalis. It arises insidiously in middle-aged or elderly men The fluid distends the tunica vaginalis, and forms a pyriform or ovoid swelling smooth on the surface, tense and elastic. As is to be expected, it is dull on percussion (in contrast to most hernias) and yields a fluid



FIG. 259. Hydrocele.

thrill. Since the wall of the hydrocele sac is thin the swelling is translucent. To test for translucency stand the patient in a darkened room and apply a pocket torch to the back of the scrotum. If no dark room is available, inspect the scrotum through a cylindrical tube, improvised out of cardboard. This test is negative in a few cases of chronic hydrocele with a thickened fibrous wall.

Diagnosis. (1) From inguinal hernia. A hydrocele is heavy dull on percussion, and usually translucent, a hernia is light, tympanitic, and translucent only in young children. A hydrocele can usually be

folded up over the abdominal wall whereas a similar procedure in the case of a hernia compresses the gut at the subcutaneous ring and causes pain. A hydrocele usually stops short at the subcutaneous ring whereas a hernia can be felt to extend through the dilated inguinal canal (but a



FIG. 260 Hydrocele folded up over groin.

large hydrocele may sometimes distend a persistent processus vaginalis upwards into the canal) It must be remembered that hydrocele and hernia may co-exist, or ascitic fluid may distend a hernial sac.

(2) From ' symptomatic hydrocele In all cases, especially in younger men, the possibility of disease of the underlying testis or

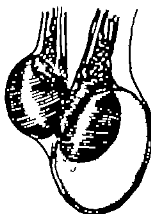


FIG. 261 Idiopathic hydrocele.

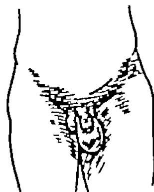
epididymis must be kept in mind. In doubtful cases the testis should be examined after aspiration.

(3) Hæmatocele. A recent hæmatocele leads to bruising of the scrotum; a late one is filled with clotted blood and is more firm and solid, and is opaque.

Treatment. (1) Aspiration suffices in some cases. To aspirate a hydrocele, grip the scrotum from behind so as to render the skin tense over the front of the hydrocele sac. Then insert a fine trocar taking

care to avoid the scrotal veins. With the scrotum gripped in this way the testis, lying at the back, is safe from injury After aspiration, support the scrotum in a suspensory bandage.

(2) Operation is more satisfactory in most cases. The sac is exposed



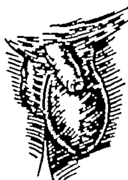


FIG. 202. Hydrocele, showing alternative incisions.

through an inguinal incision and opened the fluid is evacuated and the wall of the sac is then either excised or turned inside out round the testis. Great care is necessary to secure absolute hæmostasis. Alternatively access may be gained by an incision in the median raphe of the scrotum.

HÆMATOCELE

A collection of blood in the tunica vaginalis may be caused by bleeding from a tumour of the testis or by traumatism. It may result from injury to a scrotal vein or to the testis by the needle used in tapping a hydrocele.

A swelling rapidly develops in the scrotum, and causes considerable pain. The swelling is tense, ovoid, dull on percussion, and at first tender whilst the scrotal skin is discoloured by altered blood pigment. Later the blood coagulates and the tunica becomes greatly thickened by fibrous tissue. As a result the swelling becomes firm and hard. The testis is buried in the organised blood clot, and its characteristic sensation cannot be elicited. At this stage a hæmatocele may be mistaken for a tumour of the testis, unless the history is carefully considered.

The treatment in an early case is to make an incision in the lower part of the scrotum, evacuate the blood or clot, wash out the cavity with hot saline and insert a small drain. If the hæmatocele is left untreated, infection may gain access and the resulting abscess must be drained. In late cases it may be necessary to remove the atrophic testis.

TUMOURS OF THE SCROTUM

Simple tumours such as papilloma, lipoma, fibroma, may originate in the scrotum, but are rare.

Sebaceous cysts, on the other hand, are common. They are generally found near the median raphe, and may be multiple. Often they are small and very fibrotic, and eventually may become calcified.

Squamous epithelioma was at one time a common affection in chimney sweeps, and is still seen occasionally It also occurs in those whose occupation entails contact with paraffin products, e.g mule-spinners in cotton factories, or shale workers Modern factory regulation's have



Fig 268. Squamous epithelioma of the scrotum in a chimney sweep.

rendered the affection less common than formerly The growth ulcerates at an early stage and presents a typical malignant crater with raised rolled edges and an indurated base (Fig 268) It soon spreads to the glands in one or both groins.

The treatment is to resect the affected part of the scrotum and clear out the glands.

CHAPTER 45

RADIOTHERAPY AND PHYSIOTHERAPY

RADIOTHERAPY

THE element radium emits three types of radiation, the alpha, beta and gamma rays —

(1) The α rays are positively charged nuclei of helium atoms. They have very little penetrative power being absorbed by such a thin screen as a sheet of paper They are of no therapeutic value.

(2) The β rays consist of negatively charged electrons. They have much greater penetrative powers than the α rays, but not sufficient to render them of therapeutic value, for their main energy is expended at the skin surface, and a sufficient dosage to influence a deep-seated lesion would cause severe skin damage.

(3) The γ rays, unlike the α and β rays, are not material particles, but high frequency vibrations, of wavelength varying from 0·01 to 1 4 Angstrom Units (A.U = one hundred millionth of a centimetre) The γ rays represent less than 5 per cent. of the energy emitted from radium, but they are the part of greatest therapeutic value, owing to their high penetrative powers. The γ rays include a mixture of rays of various wavelengths, which may be distinguished as " hard " or soft " according to their penetrative powers. When the γ rays impinge on the tissues, secondary β rays are given off which are of therapeutic value.

In the therapeutic application of radium the aim is to exclude α and β rays almost completely, whilst utilising as large a proportion of the γ rays as possible. This is achieved by the use of ' filters " of various metals. Platinum represents the best filter for 0·6 mm. will absorb over 99 per cent. of the β rays, whilst offering comparatively little obstacle to the passage of γ rays.

X rays. Depending on the intensity of the current used, X rays vary in their wave length and consequently in their power of penetrating the tissues. Formerly the standard machines used for " deep X ray therapy ' demanded a current of 250 kilovolts. In recent years machines of one million volts or more have been in regular use. At the present time apparatus is coming into general use in which by means of a linear accelerator current at 4 million volts sets up X rays of very high penetration. By their use deep-seated tumours may be irradiated effectively with comparatively less exposure of superficial tissues and consequently less severe constitutional effects.

Dosage. The *roentgen* or *r* unit, which is measured by the amount of ionisation produced in a unit volume of air during a unit period of time. In calculating dosage for therapeutic purposes many factors must be taken into consideration the type and radio-sensitivity of the lesion, its position, depth, and relation to important structures.

Mode of Application. Radiotherapy may be applied clinically by the following methods —

The Radium Beam. In this method a large quantity (5 to 10 grams) of radium is used shielded in a massive lead " bomb Irradiation is carried out at a distance (usually 10 cm.) from the skin, and a short exposure suffices.

As with any form of surface irradiation the main difficulty is to avoid skin damage. The intensity of irradiation varies inversely with the square of the distance consequently if the tumour being treated is, say 2 cm. below the surface and the radium is placed 2 cm. above the surface, the skin receives four times the dose applied to the tumour If, however the radium is placed 10 cm. away the skin dosage is little more than that received by the tumour This is one of the great advantages of beam therapy

The Cobalt Beam. Here radio-active cobalt replaces the radium, giving greater penetration and in consequence a much greater depth dose.

The Surface Plaque In this method the radium is fixed upon an applicator at a distance of 1 to 4 cm. from the skin. The applicator is composed of wax, stent composition, vulcanite, sponge rubber or similar substances, and is moulded to fit accurately upon the affected part.

The plaque method of treatment is of especial value for the treatment of carcinoma of the face or palate, and for carcinoma of the cervix uteri.

Needles The needles have a wall of platinum, generally 0·5 mm. thick, and contain radium, in amount varying from ½ to 5 mg uniformly distributed throughout their active length.

The especial advantage of interstitial irradiation is that the radium can be brought into close contact with the tumour without exposing the skin to damage. Needles are commonly used for such lesions as carcinoma of the tongue or lip carcinoma of the larynx and pharynx, and carcinoma of the skin They are preferably introduced under general anæsthesia, and are left in place for a lengthy period, often for seven days.

Radon Seeds These are capillary glass tubes filled with emanation and enclosed within delicate torpedo-shaped sheaths of platinum. They measure 6 mm. long by 1·4 mm. thick. They are introduced into and around the tumour to be irradiated by means of a special trocar and cannula.

Since the activity of radon is rapidly lost, and practically ceases in fourteen days, the seeds cause little damage if left permanently *in situ*. For this reason they are especially valuable for carcinoma in such deep situations *as the pyriform fossa or tonsil*, whence it would be difficult to extract them.

Radio-active tantalum, gold and other metals are provided in the form of wire or beads or other shapes for particular purposes. Solutions of radio-active gold salts may be used, for example, in cases of peritoneal metastases.

Indications for Radiotherapy Radiotherapy finds its greatest sphere of usefulness in the treatment of certain types of malignant disease. It is most valuable for carcinoma of the mouth tongue, lip, pharynx and larynx, and for carcinoma of the cervix uteri. To a smaller extent it has been used for malignant disease of the skin, carcinoma of the breast, and malignant deposits in lymph glands It is valuable also for rodent ulcer and for various types of hæmangioma and lymph angioma.

Effects of Irradiation on the Tissues. The effects of irradiation vary according to the intensity and duration of the exposure and to the radio-sensitivity of the tissue.

The last factor is a variable one, but in general it may be stated that the greatest sensitivity is found in the highly specialised cells of the viscera, e.g the germ cells, lymphocytes, and the parenchyma cells of the liver kidneys, adrenal glands and in any cells during mitosis. It is for the latter reason that the cells of malignant tumours are particularly susceptible. The endothelial lining cells of blood vessels are also highly susceptible consequently a striking effect of treatment is to cause endarteritis obliterans in the vessels of the irradiated region, leading sometimes to thrombosis. It is for this reason that treatment is so effective in vascular tumours and in angiomata.

If the dosage is excessive, the irradiated tissues undergo necrosis, and form highly painful sloughs which take a long time to separate. The aim in therapy is to destroy all malignant cells without causing extensive necrosis. If the dosage is judged accurately the tumour shrinks, and in the course of time is replaced by fibrous tissue, which remains for a long time as a hard nodule.

Dangers of Radiotherapy (1) Patients exposed to large doses of irradiation, for example in the treatment of ankylosing spondylitis, are liable to develop severe anæmia, leucopenia, or even leukæmia or, short of such obvious diseases, they may suffer chronic ill health as a result of long-continued exposure to the rays. Recent investigations show that much smaller doses of irradiation, such as may result, for example, from repeated diagnostic X ray investigations, may damage the gonads and give rise to harmful genetic effects.

(2) Patients submitted to overdosage of irradiation may suffer from acute symptoms such as headache, nausea, vomiting, pyrexia and prostration. This is especially apt to follow irradiation applied in the region of the heart, liver or adrenal glands.

(3) Overdosage of irradiation may lead to extensive necrosis of skin and superficial tissues, and thus predispose to the access of infection. The pain of such necrosis may be greater than that of the tumour being treated.

PHYSIOTHERAPY

Physiotherapy includes the therapeutic use of heat electrical stimulation, light, massage and exercises.

Heat has been used therapeutically since the earliest times because

of its power to relieve pain. Remarkably enough, little is known of its mode of action, though it is presumed to depend partly upon relaxation of muscle spasm and partly on local vasodilatation. Heat may be applied by means of a poultice, a hot bottle or its modern equivalent the electric pad, or such special types of apparatus as the infra red lamp or the diathermy machine. Each method has its particular application though probably the physiological effects are similar The poultice is still popular for many inflammatory conditions, though in special types, e.g hand infections, it should be avoided as it makes the tissues too sodden and swollen. In such cases dry heat applied by an electric lamp or pad is better

Where it is desired to apply heat deeply e.g for fibrositis or a stiff joint, diathermy is useful (see below) Infra red rays also are deeply penetrating and probably have a similar effect.

Electrical Stimulation. An electric current applied by an electrode to the skin over a motor nerve trunk will cause contraction of the muscles supplied by it. Formerly a faradic (interrupted) current from an induction coil was used Now apparatus is available giving a flat topped wave which stimulates without causing pain For nerve stimulation a current with a frequency of three millionths of a second is used After division of a motor nerve when the process of distal degeneration is complete such a stimulus ceases to be effective, but a current of longer frequency (one hundred millionth) applied over the muscle will stimulate the muscle fibres directly

In nerve injuries and other paralyses electrical stimulation is of value in demonstrating which muscles are out of action, and in the treat ment of such conditions it is useful to maintain the muscle tone until nerve regeneration takes place.

Electrical treatment is also of some value in other conditions of muscular weakness, for example in static flat foot.

Diathermy, Endothermy Fulguration

When an electric current is passed through a poor conductor of electricity it generates heat, the degree varying with the amount of current and the extent of the resistance offered to the flow In the methods of therapy known variously as diathermy endothermy and fulguration, this principle is utilised in order to generate heat within the tissues of the body

It is obvious that electric current of the ordinary continuous or alternating types sufficiently powerful to give an appreciable heating effect would also cause an electric shock owing to its action in stimulating nerves and muscles indeed, it would be likely to cause severe collapse or even death. This difficulty is overcome by the use of high frequency alternating currents. It is thought that the stimulation effects produced by ordinary currents are due to ionic dissociation within the tissues, and since ions possess inertia their dissociation occupies a certain amount of time. If the current is made to oscillate 50 000 times or more a second, ionic dissociation cannot occur and electrical stimulation of the

nerves and muscles is obviated. Under such conditions only the heating effect remains.

In practice a current oscillating at the rate of a million times a second is used the wavelength being about 300 metres To produce such an oscillating current the alternating "mains" current is first raised, by a "step-up" transformer, to a high voltage (15,000 to 20 000 volts according to the effects desired) The secondary winding of the transformer is connected with a condenser and inductance, which discharge through a spark gap or valve, and in this way set up high-frequency oscillations.

The clinical applications of high frequency current are as follows —

Medical Diathermy Two large electrodes generally of flexible metal, are applied in close contact with the skin and held firmly in place, preferably by a rubber bandage. The current, flowing between the electrodes, warms all the tissues lying in its path. The temperature of the part may be raised several degrees. The current does not flow uniformly, but chooses the path of least resistance. It travels along muscles and blood vessels in preference to bone and fat, and consequently heats the former tissues more than the latter

Medical diathermy is indicated in a wide variety of conditions as a method of warming the tissues. It is used principally for painful affections of the joints and connective tissues, e.g in sprains, arthritis, fibrositis, lumbago sciatica. It has also been advocated for the treat ment of deep-seated chronic infective conditions such as salpingitis, prostatitis, vesiculitis.

Surgical Diathermy Endothermy, Fulguration. In this form of therapy one terminal of the apparatus is connected to a large "indifferent" electrode of flexible metal, which is bandaged in firm contact with any available skin surface, e.g the thigh. The other terminal is connected to a small flat electrode mounted on an insulated handle—the "endothermy knife." The current passing through the tissues between the electrodes exercises its greatest heating effect where it is concen trated at the knife point, and is sufficiently intense to divide the tissues with a cut as clean as is produced by a sharp scalpel. The endothermy knife has the advantage that in cutting the tissues it coagulates many of the smaller vessels in the line of the wound. It is therefore useful when operating on very vascular tissues. For larger vessels which continue to bleed when cut with the knife, a coagulating current' is provided, which is of lower voltage than the cutting current and suffices to coagulate the blood without cutting the vessel wall.

Owing to the risk of sparking between the knife electrode and a metal instrument, it is dangerous when an inflammable anæsthetic is being used. Another precaution to be taken is to ensure that the indifferent electrode is in firm contact with the skin, otherwise sparking here may cause severe burns.

Endothermy is of value also in the treatment of tumours of the urinary bladder In this connection it is generally described by the term fulguration The active electrode consists of an insulated wire.

which can be inserted into the bladder along a cystoscope, and directed under vision so that it lies in contact with the growth. When the current is switched on the tumour undergoes heat necrosis, and is thus destroyed

Short wave Diathermy

In this form of treatment the same type of oscillating current is used as in the older form of diathermy but of much shorter wavelength (10 to 30 metres) Its mode of application is different, however in that advantage is taken of what is known as "dielectric loss." When high frequency currents are passed through any kind of conductor much of the current escapes into the dielectric or non-conductor adjacent to it. Using short waves, the bulk of the current escapes into the dielectric.

In short wave therapy the patient is not placed in contact with the electrodes, but merely in proximity to them, so that the body tissues form part of the dielectric.

This method has several advantages (1) The therapeutic effect is not due to the passage of a current through the tissues, but rather to "point-heating" which has an equal effect upon all the tissues within the dielectric field. (2) Since the electrodes are not placed in contact with the skin the treatment can be applied with no disturbance to an ill person and there is no risk of burns. (3) The treatment can be carried out in the region of the eye, ear or face, or in ulcerated areas where it would be difficult to apply an ordinary electrode.

Short wave diathermy is indicated for the same types of lesion as are treated by the older methods of diathermy

Ultra violet Irradiation

The chief value of heliotherapy or exposure to sunlight, is due to the ultra violet rays and the violet end of the spectrum. They are deficient in the winter months, and in industrial districts where the actinic rays are absorbed by atmospheric pollution.

Ultra violet rays, commonly misnamed ultra violet light, lie beyond the violet end of the spectrum, and their wavelength is from 186 to 4 000 Angstrom Units (the wavelength of visible light ranges from 4 000 to 7 700 A.U) The ultra violet rays have very little penetrative power and their effects are due primarily to their action on the skin, the superficial tissues, and the blood passing through those tissues.

Formerly many virtues were attributed to ultra violet irradiation as a method of treatment, and it was widely used in tuberculosis of bones and joints and lymph glands and in various debilitating conditions. It is now doubtful if the method has any curative value, though it may be useful for its invigorating effect in patients convalescing from prolonged illness.

The usual form of apparatus is a mercury vapour lamp which consists of a quartz vacuum tube containing mercury Quartz is used owing to its property of transmitting the rays more freely than glass. The current, conducted by platinum electrodes through the quartz, vaporises the mercury and, when transmitted through the vapour emits the ultra

violet rays. It is most important that the eyes of patients and attendants should be shielded during the whole exposure, otherwise an acute conjunctivitis will be produced and cause intense pain The pain does not start till several hours after the damage has been done, so it is not safe to take the slightest risk.

Massage

A full description of the methods adopted in massage is clearly outside the scope of this book. The main objects of massage are to hasten the flow of lymph and venous blood and thus improve the nutrition of the superficial tissues, to dissipate œdema and hasten the absorption of exudates and extravasated blood, and to improve the tone and nutrition of muscles.

Formerly massage was advised for a wide variety of affections, in fibrositis, lumbago and allied conditions in various affections of joints, e.g chronic arthritis in general debility and in convalescence from any illness (to improve the muscle tone) and in many other conditions characterised by muscle atony It was also regarded as a routine part of the treatment of nearly all fractures.

When performing massage, the first step is to dry the skin thoroughly and apply a liberal dusting of powdered talc. Next, gentle stroking and patting movements should be started, the part meanwhile being kept absolutely at rest to prevent pain After a short time the limb should be gently stroked, always in the direction of the heart, using as broad a surface of the fingers and hand as possible, in order to reduce the swelling at the site of injury Later either at the first sitting or on the following day, deep stroking movements may be made, still in the direction of the heart, in order to disperse the deep exudate between the muscles and tendons. The massage should not be allowed to cause pain but, on the other hand, should have a useful effect in relieving the pain. Subsequently when the acute symptoms have passed off the deeper forms of massage described above, by kneading, pétrissage and percussion, may be used.

REHABILITATION

In its broadest sense, rehabilitation implies the restoration of the sick or injured as far as possible to health working capacity and social circumstance.

Important as is the primary treatment, it is now recognised that more attention must be given to the subsequent progress of the patient, to his convalescence, to the social and psychological problems inseparable from disease, and to the early restoration to full economic independence. These aims must be kept in mind from the beginning and throughout treatment.

The use of physiotherapy and exercises is valuable in restoring physical fitness. This is particularly so in injuries and orthopædic conditions, but also to some extent in general surgical diseases. At the present time emphasis is laid especially on active measures which

stimulate the patient to help himself rather than passive methods such as massage.

While the patient is in bed he is instructed to perform simple exercises to prevent muscle wasting and retain joint movements. When he gets up he is encouraged to perform more strenuous exercises, to undergo gentle physical training and to join in competitive games. Special remedial exercises are necessary for particular types of disability, e.g for fracture of the spine, for knee derangements, etc. All these methods may be carried out in the physiotherapy department of a hospital or in special rehabilitation centres.

Occupational Therapy apart from its value in relieving boredom, is useful in certain types of disability especially in injuries of the upper limb The occupations in common use range from light crafts, embroidery and basket work to weaving and carpentry and even such heavy work as cement mixing The occupation chosen should be suited to the particular case. For example, a man with a hand injury may be put to carpentry a man with a stiff shoulder may be put to work a loom so arranged that he must raise his hand above his head a man with a stiff ankle may be put to work a treadle, and so on.

The *Social Worker* plays a valuable part in rehabilitation. A sick person, particularly if the breadwinner of a family is beset by social and economic problems, and such worries may have a retarding influence on his progress. The social worker (almoner) is trained to study the patient against his industrial and domestic background. She can often adjust him to his change of circumstances, assist him through social and economic difficulties, and hasten his return to work.

Reinstatement in Industry is the final stage of rehabilitation. Since idleness breeds discontent, the disabled man should be got back to work as soon as practicable. Whenever possible he should return to his own job particularly if he is a skilled worker Sometimes it is advisable for him to take a less arduous job for an interim period, and in such cases every effort should be made, through the agency of the social worker the industrial medical officer and the employers, to give him work which will help him to progress towards his own job rather than stabilise him at a lower economic level.

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